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The Photo Miniature

VOLUME XIII : MARCH, 1916 : NUMBER 147

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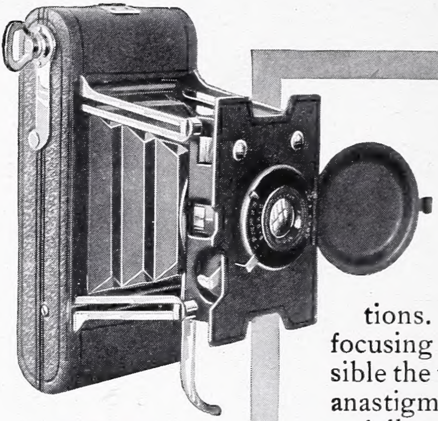

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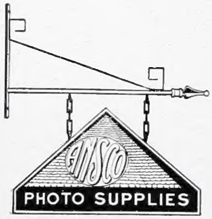

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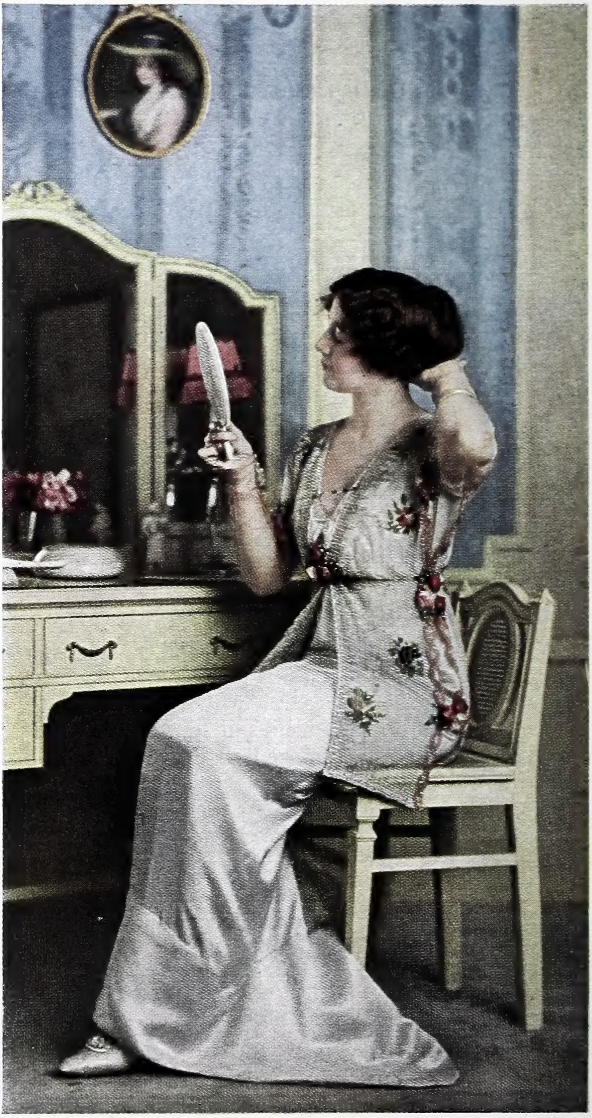

Color Portrait from Life

Reproduced from an Autochrome by John W. Allison, with Panchroma Flash Powder

The Photo-Miniature
A Magazine of Photographic Information
EDITED BY JOHN A. TENNANT

Volume XIII MARCH, 1916 Number 147

Practical Instructions in Color-Photography

Not so very long ago, I prepared for The Photo-Miniature (No. 128) an explanation of the modern methods of making photographs in color. The monograph was not a manual of practical instruction. It made no pretension to be one, for the systems and principles upon which color photography depends provide quite enough material for a whole number of this magazine, and indeed would not be exhausted in several issues, were I tempted to explore the by-paths of adventure which inventors have explored in the search for the ideal in color photography,—that is to say, a process as rapid, easy, complete, and inexpensive as the methods for making ordinary prints or enlargements. However, the earlier monograph did provide a comprehensive survey of its subject, and, though its scope is the theory or principles of color photography, it is a plain story, such as the most non-scientific of us can grasp without difficulty. It is, in fact, an absorbing narrative told without long words, as I realized again by a recent re-reading of it.

But more requires to be done. However interesting it may be to read or study the ways and means of color photography, we are not likely to be contented except by adding the practice of it to our experiences in picture-making. The rendering of the colors of nature has been the dream of photographic experimenters almost from the moment when Daguerre announced his discovery to an astonished world. The dream has been prodigiously slow in coming true; but it has at length been realized in fact, and has been accomplished in several quite different ways, two of which have come to completion within the past two years by the researches of American workers.

And so, in the present monograph, we shall turn from theory to practice, and shall set before the reader just that practical instruction necessary for success in the making of "color photographs," using that term to denote transparencies on glass as well as prints on paper. The processes we shall consider are four in number: viz., the Autochrome and Paget methods of making color-transparencies, now firmly established in this country and among European workers; the Hicro process of Mr. F. E. Ives, for the production of both transparencies and prints; and, last, the Kodachrome two-color process of the Eastman Co., devised specially for the making of portrait transparencies in natural colors, and of more particular application in professional photography. Even with this limitation of our text, and passing over processes which cannot yet be called fully practical, it will be necessary to refer the reader to THE PHOTO-MINIATURE (No. 128) for the "why" of the present methods. Here our concern is strictly with the "how."

Color Screen-Plates

The Autochrome plate, issued by MM. Lumière, of Lyons, France, in 1907, is the first commercial form of the color "screen-plate;" that is to say, a plate which bears a coating of minute intermingled transparent patches, red, green, and blue-violet in color, which record upon a sensitive emulsion, in contact with it, the redness, greenness and blueness of the subject before the camera. The Autochrome plate has the sensitive emulsion coated on the film of color patches; in the Paget process a separate plate is pressed against it. The first result of exposure in each case is, of course, a negative, which, in the Autochrome process, yields a picture in complementary colors, that is, yellow instead of blue, pink instead of green, and so on, due to the negative image leaving uncovered exactly those elements in the color-film which did *not* transmit the colored rays from the subject. But this negative image, as we shall see, is readily converted into a positive one, and then it is the elements corresponding with the original colors which remain uncovered and merge into one another, to reconstitute upon a reduced scale the color scheme of the original scene.

In the Paget process, the same final result is obtained by printing a positive transparency by contact from the separate negative, and building it up in register with a color screen identical in pattern with that through which the negative was taken. This latter plan reduces cost, as one taking-screen serves again and again, and it also allows of any number of color transparencies being made from one single exposure. So much for the bare outlines of these two screen-plate methods. Now let us come to the practical details of the older and more widely used process, the Autochrome.

What Size Autochrome?

The first thing to decide is what size of picture we shall choose. The Autochrome plates are made in sizes from 1¾ x 2⅜ to 8 x 10 in. Here their cost is roughly four times (in Britain, 8 times) that of ordinary plates, so that expense will be a prime factor in selecting a size. If the results are for lantern projection, then obviously choice will be made of the 3¼ x 4¼ or the 3¼ x 3¼, the latter the standard British lantern size. But, if one's aim is to make larger transparencies, the alternatives are the 4 x 5 and 4¾ x 6½ in. (or 5 x 7 in.) sizes, either of which affords a picture of ample size. The largest size of all (8 x 10 in.) is one which few amateurs will wish to adopt, when it is considered that each plate costs considerably more than $1; although it should be said that the bulk of the expense of the process is in the plates. Chemicals, etc., cost no more than for ordinary photography.

The Camera

In Autochrome work, the camera must be used on a stand. The plates are not rapid enough for shutter exposures. Apart from the means for holding the plates, to which I will come in a moment, the particular model of camera is not a matter of importance; but there is some advantage in having one a size larger than the plates. The reason for this is that, by holding each plate in a kit (carrier), it is possible to hinge the black card (which has to be placed behind each) to the kit with a strip of gummed paper, and so to prevent its damaging the film by rubbing against it. This applies to plate-holders of both the American and English (book-form) patterns.

If the view is focused on the ground-glass of the camera by eye in the usual way, it may be necessary to turn the focusing screen the other way about, i. e., with the ground side to the rear. But this is necessary only when the special light-filter or ray screen is fixed on the front of the lens, for the reason which we shall see directly. The best position for the filter is behind the lens, and, if it is placed here, focusing may be done by the scale fixed to the camera. However, considering the cost of each exposure, it is much better to focus and arrange the subject by eye than to trust to any focusing scale.

Plate-Holders

But the most important feature in the outfit is the type of plate-holder. Undoubtedly the English book-form model (*Anglice*, dark-slide) is the most convenient, for the reason, just stated, that the plate can be laid in (glass side to the front), and the backing card brought against the delicate film surface without rubbing it. With the solid pattern of plate-holder, it is not so easy to adjust matters satisfactorily in this respect, if the camera is the bare size of the plate. But by using a kit the plate can be laid in, the hinged black card placed over it, and the whole then inserted in position in the holder, with the film side of the plate securely protected. With holders of the pattern in which two plates are slid in from one end, I advise their being carefully bound up with the black card (or two cards) between them before insertion in the holder, otherwise the film is almost certain to become rubbed in the process.

The Lens There is nothing special about the lens for color processes, except that it should be one of high-grade, fairly large aperture, and free from color. The aperture should not be less than *f*/8, is better if *f*/6, whilst a speed of *f*/4.5 is very often of real advantage. Apart from the shortening of exposure, and therefore lessened risk of movement in the subject, a large aperture, such as one or other of those just mentioned, yields a better result than that obtained with a lens at *f*/16 or smaller. The Autochrome differs from ordinary plates in this respect to a marked degree, so one of the first rules I would impress is to use the full aperture of the lens whenever that is possible. *f*/6 is about the most useful for all-round work. As regards focal length, you will not go far wrong in using a lens of focus a little longer than the long side of the plate. It cannot well be much shorter than this, for then it will be found not to cover the plate, and it is necessary to avoid extra length of focus (desirable as that may be pictorially), for then it is impossible to combine good depth of focus with the use of the full aperture. Generally speaking, an anastigmat type of lens is the best; although some workers have made good use of a soft-focus objective, on account of its pleasing massing of tones. But such a lens requires to be one in which the diffusion is obtained by spherical aberration, not, as with some, in part by chromatic aberration.

The Filter This is a most important part of the outfit. It is used in order to compensate for the extra sensitiveness of the plate to blue rays, and therefore only the special filter made by MM. Lumière may be used. The filter may be placed either in front of or behind the lens. If on the hood, care must be taken to attach it so that not an atom of white light can get between it and the lens. Any slight leakage, which would be of no moment in orthochromatic photography, will cause a bluish tint in the Autochrome. If by accident the filter is not used in making an exposure, the result is a transparency, with scarcely any color but blue in it. The Autochrome light-filters are supplied both square and circular, and either shape may be fixed to the lens by means of a ray-filter holder, of which several patterns are made by the Eastman Company for their Wratten filters, either to fit the lens-hood or to be fixed behind the objective. A very effective holder for a square filter on the hood can be easily made as follows: Cut two pieces of three-eighths-inch whitewood, each one-half inch larger each way than the filter, making a central aperture in each a shade larger than the lens-hood. Then cut three strips of wood the same thickness as the filter, one-fourth inch wide, and also half an inch longer than the filter. Glue these flat around three sides of one of the square pieces, and then glue down the second piece on to them, finally cutting off two short lengths which project. All the pieces should be dead-blacked on both sides before putting together. Completed, they form a kind of open narrow box, or cell, into which the filter is lowered. One central hole pushes on to the lens, or a deeper brass rim may be screwed to the holder and lined inside with black velvet for greater security. The filter, which should be about half an inch larger than the diameter of the lens-hood, is thus secured on all sides from passage of white light. A similar device can be used for fitting the filter behind the lens, if the tube projects far enough, or the screen can often be more simply attached to the rear side of the lens panel by glueing a narrow shelf for it to rest on and fixing a couple of turn-buttons to keep it in place. So long as the filter fully covers the lens, there is no need to worry about a light-tight joint, since its position inside the camera excludes the possibility of stray white light.

Placing the Filter

It is most important to keep the filter protected from light when not in use, for, with much exposure to light, the filter darkens somewhat, and then upsets the proper color-rendering and also prolongs the exposure. With ordinary care, a filter may be kept in use for years without undergoing any change, but it must not be regularly carried on the lens, exposed to the bright light which would fall on it in the course of a day's work out-of-doors. For this reason, it is better to fix it in the camera, and so to save the trouble of taking it in and out of a case, or forgetting to use it. There is another reason for preferring the behind-lens position, namely, that then we can avoid reversing the focusing screen in its frame in order to compensate for the plate being placed glass side to the lens. This may appear mysterious until I explain that the result of interposing a flat glass filter in the path of the rays from the lens is to throw back the focus by a distance equal to one-third the thickness of the filter. Now, in exposing an Autochrome, there are in reality two filters—the yellow ray-screen and the glass of the autochrome plate itself. The thickness of the yellow filter is 3 millimetres; that of the plate averages 1.5 millimetres. Hence the setback of focus is 1.5 millimetres, which is exactly the average thickness of the plate. Thus we can work on one or the other of two plans, whichever is judged more convenient: (1) Use a camera with the focusing screen in its ordinary position, focus *without filter*, and bring the filter into position *behind the lens* for exposure; or (2) use the ground-glass in reversed position, focusing *with the filter in place behind the lens*. If the filter is used on the front of the lens, the ground-glass must be reversed, and focusing may be done either with or without the filter, as the latter is then without effect on the focus.*

Whichever plan be used, it is worth while to compare the thickness of the focusing screen with that of the Autochrome plates; and, if there is any appreciable difference, to get a fresh piece of fine ground-glass.

The Autochrome Plate

So much for our equipment. Before we go on to make our first essay in Autochrome work, we may dwell, for a moment, on the special properties of the Autochrome plate, since these plates must be handled with much more than the usual care in several respects. First, the Autochrome is highly color-sensitive. It is fogged by deep red light, much as an ordinary plate is fogged by white light. The only safe light in which to handle the plates is a very deep green; but it is better to place them in the holders in total darkness, and to use a safe-light only for development, when, as we shall see, their sensitiveness can be so greatly destroyed as to allow of a comfortable light being used.

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*This is so only when the subject is a considerable distance away, e. g., a general view. It does not hold good when copying very near objects, i. e., when the lens requires to be racked-out much beyond its normal extension. In such conditions, it is best to use the filter behind the lens.

Next, in the dry state, the plates are much more than ordinarily sensitive to damage by finger-marks. They should be handled by the edges only, and on no account laid down with the film in contact with anything. This caution is all the more necessary, since the glass side of each plate requires to be cleaned before placing in the holder.

Last, in the wet condition, the surface of the plate is extremely soft and tender, almost sticky. A gelatine plate is as tough as leather in comparison with it. You musn't touch it with the finger and expect to see it undamaged. Any local treatment in the way of reduction, etc., must be done with absorbent cotton thoroughly wetted with the solution.

A word should be said on the keeping quality of the plates, since the makers mark each packet with a date indicating a period within which they should be used. As this date represents only four months from manufacture, it may easily have been reached by the time the plates get to non-European users, who may therefore think them unusable. In point of fact, as MM. Lumière themselves say, the plates keep much longer than this; under good conditions (away from heat and damp), for a year or more. General experience is that they are little inferior in this respect to other color-sensitive plates.

As regards the finished transparencies, varnishing supplies protection against physical damage; their permanence toward light is such that they will remain unchanged for years in ordinary indoor conditions, although the colors suffer by continuous exposure to strong daylight. And, even when varnished, the plates will not bear *long* exposure to a great degree of heat, such as that of a stereopticon. A not unusual result of over-heating is total disappearance of the colors, due, no doubt, to the emulsion shifting out of register with the color-film through unequal contraction of the films.

Loading Plates The safest plan is to load the plate-holders in darkness, as can easily be done with a little system beforehand. First place the holders (and kits, if they are used) ready to hand. Then, unless you have previously hinged a card to each kit, place together the cards for backing up the plates. They are best laid black side down, this being the side which is placed next to the film. The plates are packed in pairs, film to film, with a thin paper between each, so that there is no difficulty in knowing the film side without touching. Then, holding a plate by its edges, carefully wipe the glass side with a clean piece of wash-leather, and lay in the holder, or kit, glass side outward. I prefer not to dust the film side at all—only to give the plate a smart rap on the bench to dislodge any chance particle of dirt; but the glass side should be well cleaned with chamois wash-leather, since particles of dust upon it are liable to cause black spots in the finished result.

Some workers, I know, prefer to load by a green safelight. No doubt this is quite safe if one is expeditious, and is careful to handle each plate so that the glass side is turned toward the light. The color-film stops a great deal of light; in fact, the Autochrome, when shielded by the color-film, is a slow plate, although sensitive to all colors. A skilled worker may handle it in fairly bright green, or even red light, without any evil effects, but my experience is that it is most satisfactory to load the holders without any light whatever. Fog at this stage will cause general flatness of the final transparency, if the light falls on the emulsion side of the plate, while fog caused by light coming *through* the color-film leads to a tint corresponding in color with that of the safelight.

Subjects The beginner in color-work usually cannot resist the temptation, for his first experiment, to collect a veritable feast of color in front of the camera. Natural curiosity overpowers him to "see what the plate will do," and therefore he crowds the gayest collection of flowers he can get together against a background of vivid hue. The hideousness of the result is generally in direct proportion to the care which is bestowed upon the composition of the subject. Let the reader be persuaded to forswear these artificial triumphs, and to seek subjects as he does in ordinary landscape work, but with a sharpened sense of color values and masses. A whole monograph might be written on this part of our subject—perhaps some day I may attempt it,—but here I must advise the reader, whose aim is a pictorial one, to begin by seeking subjects in which colors harmonize, rather than those in which the effects impress one by their contrast. He is then far more likely to get results which will charm the beholder, not merely from the wonder of them, but strictly for their intrinsic beauty. Most of us are utter novices in color, just as we are novices in the tonal values of ordinary photographs. In color, the opportunities for committing artistic crimes are as many as in ordinary photography—nay, more numerous, and therefore I say, play for safety at first by looking for subjects without clashing colors, the ordinary landscape with trees in masses, a fairly heavy foreground and generous sky-area—for example.

Another hint on this choice of subject, and I will leave the reader to himself in this superlatively fascinating field. Seek also "bigness" in your subjects, i. e., masses of color rather than a lot of multicolor detail. Even when technically perfect, the color photograph suffers from the smallness of its size. For many of the subjects which are attempted in autochrome work, a painter would choose a big canvas, realizing that a facsimile on a reduced scale is not a facsimile at all as regards its effect on the human beholder. We cannot follow the painter in his choice of a large-scale picture, but we can mitigate the effect of reduction by discretion in the choice of the subject. As the outcome of making and examining Autochrome and other color transparencies for the past nine years, I believe that the above two hints embody a creed sufficient to save the color-worker from artistic damnation. And, having said that, let me turn to the next step in practical work, viz., exposure.

Exposure The speed of the autochrome plate is reckoned through the color-film on the glass and through the lens-filter. These two together make the plate a slow one in actual work. MM. Lumière indicate its speed by directing an exposure of one second in midday summer sunshine, with *f*/8 stop and for an average fairly near subject of not unduly strong character. This means that in working speed the plate is 60 to 100 times as slow as an extra-rapid ordinary plate. But, with the autochrome (with the Paget, too) it is necessary to give considerably more than the proportionately longer exposure when a small stop is used, or when the light is poor, due to the time of year or day, or to the exposure being made indoors or under trees. In other words, the plate is slower to a weak light than to a strong one, and it matters not whether it is the stop, the dullness of the sky, or the poor illumination, which causes a low intensity of light on the ground-glass. In bright light, with outdoor subjects and a large stop (the best conditions), the speed of the plate is 2 Watkins or 14 Wynne. An exposure-meter is a great help. The Watkins firm issues a special dial for the Bee meter, on which the extra-long times are indicated. I have found this meter very reliable in use, but with others similar provision may be made by taking a lower speed number as the light is poorer. Thus with the Wynne, use a speed number of 11 in diffused light, and 8 for exposures indoors or when the outside weather is dull; 14 in bright light. In addition to this factor, allowance requires to be made for the smaller stops. There is no need to trouble about these for *f*/8 and larger, but from *f*/11 downward a good rule is that of Biermann, viz., to give 2½ times the exposure for each reduction of the diaphragm which, in ordinary work, would mean doubling the exposure. Thus, if the light is such as to require 2 seconds at *f*/8, the exposure at *f*/11 should be 2½ times that, or 5 seconds; and at *f*/16, 2½ times again, or 12½ seconds. Practical familiarity with the factors governing exposure with ordinary plates is the best aid I can suggest for successful work with color plates.

A Working Exposure System

Thus I advise the reader to do one of two things: Either get a Watkins Bee meter, with color dial, and follow its indications; or use a Wynne meter, in the customary way, except that you choose a plate-speed of 14, 11 or 8, according to circumstances, *and*, if you use a medium or small stop, that you further increase the exposure (at *f*/8) by as many 2½-time steps as are called for. If *f*/11, this will be just 2½ times; if *f*/16, 6¼ times; if *f*/22, 15½ times; in each case in comparison with the *f*/8 exposure shown by the meter. But let me say, again, that dull light or small stops are things to be avoided in Autochrome work. It may be that our present knowledge of the correct exposure to give under these conditions is still incomplete. At any rate, general experience is overwhelming in showing the better quality of result as regards color-rendering, transparency, and that indefinable "richness" which is got with a large stop and bright light. As regards the character of the subject itself, this requires to be taken into account just as in ordinary photography. The exposures found by meter are for an average fairly near subject, and may be halved for an open landscape, or doubled (or more) if the foreground includes dark heavy masses.

Using a Large Stop

When it is found impossible to get the various parts of the subjects all into sharp focus without stopping down the lens, some part must, of course, be sacrificed; but a great deal can often be done by the use of the swing back, side-swing, or swing-front of the camera, to adjust matters so that near and distant objects can be sharply defined without resorting to a small stop. The most common dodge of this kind is to swing the camera back to the rear, so that the upper part of the focusing screen leans away from the lens. This helps to get the immediate foreground in sharp focus at the same time as the more distant parts of the subject. Tilting the lens downward has the same effect, the lens also requiring to be lowered on its front. In a similar manner, the side-swing of the camera back can often be used to get a near foreground object to the right or left of the picture into focus at the same time as distance on the other side of the subject. These are dodges familiar to the old photographic hand, and my apology for mentioning them here is their special utility in color work out-of-doors.

The Dark-room Light

Autochrome plates are best developed as soon as possible after exposure. On tour, the process need be carried only so far as re-development, and any other manipulation left to the return home without any ill effects. The plates can be handled entirely without a dark-room, if one develops for a fixed time; but it is much better to be able to watch development, and, therefore, I refer here to the one or two points of real importance in the use of a dark-room. The chief of these is the safe-light, which should consist of several thicknesses of the yellow and green "Virida" papers, which MM. Lumière supply very cheaply. Two green and three yellow papers are enough for use with an oil lamp; more may be necessary for more intense lights, such as electric metal filament lamps. The papers are placed between two pieces of glass, which are bound together passe-partout fashion with a gummed strip. A brighter light can be used if the lamp is so placed that rays can reach the plate only by reflection, e. g., put the lamp on a shelf and handle the plate underneath it. This makes for greater comfort; but beware of any arrangement under which it is possible for such stronger light to fall directly on the plate.

Gentle Water Supply

Another very necessary precaution is to avoid any strong pressure of water from the faucet. The plates get several rinsings between the various baths, and such are better done under a stream of water than by rocking in a dish. The ideal plan—and a very simple one—is to stand a jar of water on a shelf a foot or two above the work-bench, and to lead the water from it by a siphon tube, with a rose jet and tap fitted to its lower end. The pressure from this small head of water is small, and cannot injure the delicate film, as the stronger force of water from the faucet might do. Prevention is better than cure in dealing with Autochrome plates.

A One-Dish Process

The rest of the manipulative outfit is not formidable. Apart from the stock solutions, and one or two graduates, it consists of one dish. Autochromes are not plates to be dealt with in batches. Each should be carried through by itself, and the thinness of the film is such that with the most lengthy procedure half an hour is ample for the process from first to last. The best dish is one of glass. One can be sure that it is perfectly clean at the start, and it cannot absorb chemicals, as can one of porcelain ware in imperfect condition. Choose as shallow a dish as you can get; it is then easier to rinse the plate between each bath, without taking it from the dish, which is the right way to work. Frilling, which was a nuisance with many of the first batches of Autochromes, has been largely overcome by the makers; but it is still wise to avoid all unnecessary contact of the fingers with the wet plate.

Development

The Autochrome is unlike any other plate in that the development is only a first step to the final result. The negative image is developed, and is then at once dissolved away by a powerful solution which, however, is without action on the emulsion unaffected by the development. Then comes "re-development," but, let us remember, of the original emulsion *minus* the negative image and thus producing a positive. If we bear the mechanism of this reversal in mind, we shall understand that excessive density in the first development (due to over-exposure) means a thin weak positive on re-development; and *vice versa* a weak negative, from under-exposure in the first instance, results in a dense, heavy positive. Similarly, anything which stops light affecting the plate in the camera, e. g., dirt on the glass at the time of exposure, leaves the emulsion untouched by the first developer, and so leads to a dense black spot in the re-developer—just the opposite of ordinary negative-making. If this inverted order of things be clearly recognized at the start, the beginner will be saved much unnecessary bewilderment at the effects of errors in exposure and development. These differences should be recognized.

Developer At the first introduction of the process, pyro was recommended for the first development and amidol for redevelopment. Many leading workers still prefer this to the simpler method with metoquinone, which reduces the number of stock solutions for this part of the process from 4 to 2. But I advise the beginner to start with metoquinone (quinomet), preferably buying the concentrated solution. If the developer is made up, I advise using twice the quantity of water and taking double as much in comparison with the purchased stock. This, for the reason that there is often some difficulty in getting the metoquinone to dissolve completely to form a full-strength stock. The half-strength formula is: Warm water, 70 ounces; metoquinone (quinomet), ½ ounce; soda sulphite, dry, 3½ ounces; liquor ammonia (920), 9 drams; potass. bromide, 90 grains. The water should be about 100° F. (about as hot as the hand can bear comfortably), the quinomet dissolved in it, then the sulphite and bromide, and then, when cold, the ammonia added. This stock solution will keep in good condition for a month or two. To make the working developer for a correct exposure, 1 part of the bought stock is mixed with 4 parts of water, or, if the half-strength stock, made up as above advised, is used, 2 parts with 3 parts of water. For a 5 x 7 plate use 5 ounces of the working solution, putting it in a graduate, to which it is returned for use in redevelopment. The only other bath required is the reversing solution.

The Reverser This is made up with potass. permanganate and sulphuric acid, each of which should be kept as a separate stock solution, and the reversing bath made at the time of use by mixing equal parts of each. The ready-mixed or used bath does not keep well, depositing brownish flakes which mark the film. The stock solutions are: *A*. Potass. permanganate, 35 grains; water, 20 ounces; *B*. Sulphuric acid, concentrated, 3 drams fluid; water, 20 ounces. In making these solutions, use warm water for the permanganate, and make sure that every particle is dissolved. In making *B*, note that sulphuric acid is a highly corrosive liquid. It should be added to the water (cold) not *vice versa*. The working solution is made by mixing equal parts of *A* and *B*, the mixture corresponding with the Lumière *C* solution, to which reference will often be found in articles and booklets on the process. For the treatment of a plate, 3 or 4 ounces of the mixed reverser is placed to hand in a graduate, and we are then ready to begin.

Developing

Owing to its very thin film, the autochrome plate develops quickly. If exposure is about correct, development is complete in 2½ minutes. The usual mistake is to over-develop, therefore it is a good plan to check the time by a watch or, better, a clock such as the Eastman Timer, with a bold dial, which can be plainly seen in the dim green light. For the same reason, wait a minute or two, before beginning operations, for the eyes to get accustomed to the faint light. Handle the plate as far as possible from the light, flooding on the developer with an even sweep over the plate, and immediately covering the dish with a card. After about half a minute, you can take a look at it as it lies in the dish. If, with approximately correct exposure, the image should be plainly visible. The color-sensitiveness of the plate is now greatly reduced, and there is no harm in leaving it uncovered. In now judging the progress of development, forget all your preconceived ideas of what a negative should look like. The autochrome is judged by looking at it, not through it. In fact, it should not be taken from the dish at all until ready to be dried. The plate should be allowed to gain strength in the developer until there is a slight gray deposit over even the heavy shadows, whilst only the extreme high-lights look black. When it is done, it should have pretty much the appearance of a negative on an ordinary plate which has been under-exposed and fully developed; that is to say, there should be no tendency for the detail to be buried in general density; it should all be there plainly visible as the plate lies in the dish. Positive under-exposure is shown by only the highest lights coming up on the plate, whilst over-exposure may be recognized by the growth of density.

Over-Development

One effect of over-development is hardness of result; the final transparency is thin, but has the harsh appearance of a print from a hard ordinary negative, tending to a crude-looking color-rendering. A further evil from the same cause is pinkiness of the high-lights, such as the sky. A moment's thought will show how this comes about. If you take a spoilt Autochrome and rub off the emulsion film, you will see that the color-coating is not pure gray, as it should be in an ideal screen-plate, but pinkish. If you develop too thoroughly, the highest lights of the subject are reduced right through the very thin emulsion and, on dissolving the deposit away in the reverser, the pinkish color-film is left bare. Re-development does nothing to improve matters, because there is no undeveloped emulsion left. This eating-out action of excessive development is very pronounced. With less development, the high-lights, after reversal, are left covered with a thin deposit, which serves to mask the pink coloration of the screen itself. This it does through the correct adjustment of the lens-filter to the plate. The filter is made so as to provide a corrective for the tint of the color-film, but, as I have just shown, its action is made of no effect if the plate is so fully developed as to leave the high-lights entirely destitute of deposit after reversal. From which it will be seen that a great part of the art of developing autochromes consists in getting sufficient general detail and gradation, whilst avoiding this excessive density in the high-lights.

Biermann's Methods

In this connection, I quote here the methods for the use of the metoquinone developer recommended by Mr. E. A. Biermann, whose very fine Autochrome work is done as a branch of his three-color engraving business. Instead of sticking to the standard strength of the developer, use it weaker except for subjects in very dull light. Thus, for subjects in bright sunshine, the Lumière full-strength stock solution is mixed with 8 times its bulk of water, or 10 times if the subject is very brightly lighted. If sunshine, either direct or diffused, is absent, a strength of 1 part stock to 6 parts of water is adopted, and the normal 1-in-4 strength used only for known under-exposures, subjects in very dull light, or interiors without windows showing in the picture. As regards the time of development, Mr. Biermann has a rule of his own, for use with developer of any strength. Working in the green safelight, he pours on the developer and starts counting seconds. At the first sign of an image, not reckoning the sky in outdoor subjects, a note is made of the number of seconds and the dish is covered. Then the full time of development is found by multiplying this time of appearance by itself and then by 4. Thus, if image appears in 6 seconds, time is $6 \times 6 \times 4 = 144$ seconds, or 2 minutes 24 seconds, seen from a table of appearance-times of from 2 to 15 seconds. If the image does not appear in 15 seconds, the plate is under-exposed, and it is best to strengthen developer to 1-in-4 and develop the plate for 15 minutes.

Washing

I shall return to other development methods directly, but now I will pursue the straightforward process which I recommend the beginner to adopt. When development is judged sufficient, pour off the solution into the graduate for use again, and at once rinse the plate for one minute. The best way to do this is to hold the dish at an angle, under a gentle stream of water, so that the water runs off, as it will do from a shallow dish. Soaking the plate in water helps to produce frilling of the film, if there is any tendency that way. In that case, a good plan is to replace the developer with saturated solution of alum, immerse the plate for two minutes, and then rinse before proceeding to the reversing process.

Reversing

After this brief rinse, the reversing bath is poured over the plate, which may then be taken out of the dark-room and completed in full light. Three or four minutes is ample for the reverser to act. It is then poured back into a graduate, if other plates are to be treated; if not, it is thrown away. At this stage, the color-transparency first becomes visible (on holding the glass dish over a sheet of white paper), but much weaker and flatter than it subsequently appears on re-development.

The next step is to rinse the plate, in the way already directed, for half a minute before proceeding to redevelop.

Before leaving the reversing bath, it may be mentioned that some workers have preferred bichromate to the usual permanganate formula. A formula is: Potass. bichromate, 30 grains; sulphuric acid, 1 dram; water, 15 ounces. This solution keeps indefinitely, but in other respects is not better than the permanganate, except, perhaps, as a means of avoiding green spots, of which more will be said later.

Re-Development When the metoquinone developer is used for the first development, the solution does again for re-development. In Biermann's method also the weaker developer, at all strengths from 1:6 to 1:10, is quite satisfactory for redevelopment. In this latter operation, the two important points are: (1) To expose the plate to weak daylight or strong artificial light before applying the developer, and (2) to allow ample time (4 minutes) for full action of solution. Without exposure to light the white image will not darken fully in the developer. If one is working by daylight, the illumination which the plate receives whilst being rinsed and whilst in the redeveloper is usually enough. Strong sunlight is best avoided. At night, stand up the dish containing the plate and burn 3 inches of magnesium ribbon at about 6 inches' distance, or expose for a minute or so a few inches from a 50-candle-power electric bulb.

As regards the action of the re-developer, this must be thorough. It is not enough to keep the re-developer on only until the plate appears to have darkened completely. That will probably leave a certain amount of unreduced silver bromide in the film, leading to loss of vigor if a fixing bath is afterwards used. In the process so far described in these pages, no fixing bath is needed. The reverser removes one part of the silver compounds and the re-developer reduces what is left; but, if the plate is intensified, it is then necessary to fix for the sake of permanence.

After about 4 minutes in the re-developer, the plate is rinsed for 3 to 4 minutes. If this longer rinse is not done in the dish (tilted for the water to run off), the next best plan is to lay the plate face up on a good-sized graduate, or better a block of wood, and let a soft stream of water run over the surface for the prescribed time—not longer.

At this stage, if all has gone well, we have the finished transparency, save for drying and varnishing. It should be clear and brilliant. If too thin and weak in coloring from over-exposure, it can easily be improved by intensification. If muddy and dark from under-exposure, something, though not very much, can be done to remedy matters by reduction. We will postpone these processes for a while in order to refer to other developers and methods of development; but must first say a word on drying and varnishing the Autochrome, which, of course, calls for no further chemical treatment.

Drying

Although the Autochrome plate, owing to its very thin film, dries in an hour or so in the ordinary way, it is just as well to assist matters by whirling it before standing it aside. This gets rid of all adhering water in the only possible way—for the film cannot be mopped—and avoids scum markings from tap-water. Some workers have improvised efficient whirlers by attaching a good-sized rubber bulb—the pneumatic holder of wet-plate days—to an egg whisk. The commercial whirler made for process workers can be obtained from dealers. A whirler is a most useful thing to have at hand if plates frill; for it is most efficient in checking the defect as soon as there are signs of it, whirling the plate until quite dry, which will be in a minute or so. Means can then be taken to prevent the frilling spreading, although the rapid drying is often enough of itself to obviate the difficulty.

Varnishing

The transparencies gain distinctly in clearness and brilliance by being varnished, but, apart from this, varnishing should always be done for the protection of the delicate film against damp or accidental damage and, in the case of lantern slides, as some preventive of damage by heat. The varnish must not contain spirit (alcohol), which dissolves the coating, separating the color-film from the emulsion, and so loosens the latter. Gum dammar, 1 ounce, dissolved in 10 ounces of pure benzole, is a good varnish, and I believe that supplied by Lumière is of this kind. Celluloid varnish, if free from spirit, is just as good and is easily made by soaking clean strips of celluloid in amyl acetate until no more will dissolve, although it is better to buy a reliable varnish ready-made than incur the mess and trouble of making it. It is used cold, pouring a liberal quantity on to the middle of the plate, which should previously have been very carefully wiped with a soft silk handkerchief, rolled up to a pad, in order to remove all particles of dust. The varnish readily flows to the corners, on tilting the plate slightly, and the excess is drained off from the last corner to a second bottle, keeping the angle of the plate moving to and fro in the bottle neck as long as any drops fall, and so avoiding streaks in the coating. If you have a whirler, put the plate on it at once; the coating will then dry quickly and evenly, and has not so long to pick up dust. But fix some kind of screen around, e. g., a cardboard hat-box, to catch the varnish which is thrown off. If not whirled, simply stand the plate on one side somewhere, where no positive heat can come to it. When the coating is dry and hard, any varnish which has got on to the glass-side can be cleaned off with a rag just moistened with gasoline.

The Pyro Developer

Now I retrace my steps in order to say something on developers other than metoquinone which can be used with advantage. As originally introduced, the Autochrome process included pyro as the first developer, amidol as the re-developer, with intensification as an indispensable after-treatment, involving a formidable series of seven successive operations, not reckoning the same number of rinsings, and calling altogether for nine stock solutions or baths. By the introduction of the metoquinone developer these latter have been reduced to three, which is an undoubted boon so far as convenience is concerned, but, on the other hand, does certainly involve a lesser degree of control over the result when the exposure has not been practically correct. On this account, and apart from the practice of always giving at any rate some intensification—leading workers have vigorously disagreed upon this point—pyro is still preferred by many skilled Autochromists, both in France and in England. Results do certainly justify the preference, and therefore I include here a formula, that of Mr. Jas. A. Sinclair, one of the first English workers to show technically faultless Autochromes. Stock solutions: *A*. Water, 10 ounces; potass. metabisulphite, 5 grains; (or soda bisulphite lye, 5 drops); pyro, 160 grains. *B*. Liquor ammonia, ·880, 400 minims; potass. bromide, 135 grains; water, 8 ounces. To make the working developer, mix ½ ounce of *A* with 5 ounces of water, and measure ½ ounce of *B* in a separate graduate, adding it to the diluted pyro stock immediately before use. The developer must be used for one plate only.

Developing in Ample Light

A method of comfortable working, which some leading workers have used, is that suggested by Dr. Drake-Brockman, viz., to give the plate a preliminary minute (*in total darkness*) in a bath of potassium metabisulphite, 130 grains, in 10 ounces of water. This treatment very largely destroys the color-sensitiveness of the plate, allowing of the development then being done in a fairly bright red light. The plate must be washed for about a minute on removal from the metabisulphite bath, and may then be developed with pyro, metoquinone or other developer. Probably, any developing solution has a great effect in reducing color-sensitiveness, but the advantage of Dr. Drake-Brockman's system is that you start development with ample illumination, and thus are able to judge more readily of the appearance of the image at the most important stage of the process, though you should still avoid unnecessary exposure of the plate.

Dillaye's Method

A modification of this plan has been worked out by M. Dillaye, who uses a mixed bath of soda bisulphite and potass. bromide. The latter is for the purpose of restraining the action of the developer, and so enabling it to deal better with shadow detail, which, from the fact that the plate is exposed glass-side to the lens, is formed chiefly in the lower part of the sensitive film. The formula for the bath is: Potass. bromide, 100 grains; soda bisulphite lye, 3 drams; water, 20 ounces. The plate is kept in this (in total darkness) for two minutes, with constant rocking, then rinsed (in red light but with as little exposure to it as possible), and developed in the usual way with metoquinone, Lumière formula. This method is similar in effect to the use of weaker-working developer, as directed by Biermann, and is well suited to subjects of great contrast under bright lighting.

Other Re-Developers

While the metoquinone used for the first development is quite satisfactory, as the re-developer and saves multiplying solutions, pyro, as I have said, cannot be used for this purpose. With this latter, amidol is the best re-developer. The exact formula does not matter particularly; any strong amidol developer containing about 4 grains of amidol and 20 grains soda sulphite cryst, per ounce of water, with no bromide, answers well, and is preferable to an alkaline developer, if plates give trouble in the form of frilling. Rodinal, of strength 1 part mixed with 20 parts of water, is another convenient re-developer.

Intensification

In the early days of the process, it was the custom to intensify every plate. MM. Lumière so directed, but many of the Autochromes of the first few years were faulty from over-intensification, the effect of which is to make the transparency of excessive density, and at the same time to render the colors harsh and wanting in luminosity. Gradually it has become recognized that intensification will effect no improvement, but the reverse, in a properly exposed and developed plate, and that, even when some intensification is called for, it is better to do too little rather than too much of it, and so to avoid garish color-rendering. A good deal depends on how the first part of the process is carried out. If exposure is full, and the first development moderate, the result is one which requires a fair amount of intensification to give brilliance in the final transparency. On the other hand, with shorter exposure and normal development, there is less call for intensification. The former plan is the safer, for in development we must rely on judgment and experience in gauging the effect, whereas in intensification we see the action taking place. This is particularly so in Autochrome transparencies for lantern projection, which require to be both thin and brilliant, a result which is gotten by full exposure, fairly full development, and intensification *quant suff.*

The Intensifier

Although various intensifiers, such as chromium, mercuric iodide, mercury ammonia, and "Agfa" can be used, there is none which is at once so suitable for the purpose, or so satisfactory as regards permanency, as that originally directed by MM. Lumière, viz., an acid mixture of pyro and silver nitrate. The process is carried out on the plate after re-development, and calls for five solutions, three of which, *F*, *G* and *I* are kept at stock, whilst the other two, *E* and *H* are made up at the time. I use here the letters adopted by MM. Lumière, since in much that is written on the autochrome process the solutions are referred to only by letter. First, the stock solutions:

F—Pyro, 25 grains; citric acid, 25 grains; water, distilled, 20 ounces. This keeps badly, owing to a fungus growing in it. The addition of 40 grains of salicylic acid to the formula will avoid this, in which case, dissolve the salicylic acid in 2 ounces of hot water; and add to the remaining 18 ounces, after the other chemicals have been dissolved in the latter.

G—Silver nitrate, 90 grains; water, distilled, 4 ounces.

I—(Fixing Bath)—Hypo, 3 ounces; soda bisulphite lye, 1 ounce (fluid); water, 20 ounces.

The two solutions to be made up at the time of use are:

E (Oxidizer)—Permanganate reversing bath (working mixture of *A* and *B*, as given on p. 111), ½ ounce; water, 25 ounces. This is used for destroying all redeveloper left in the film.

H (Clearer)—Stock permanganate, *A* solution as given on page 111, 1 ounce; water, 3 ounces. This is for the removal of any yellowish stains from the intensifier.

N. B.—These two solutions must not be confused. *E* is acid and, if used in place of *H*, would partly remove intensification. *H* is non-acid and would be ineffective for destroying re-developer.

Intensifying

First rinse the plate, after re-development, for half a minute under the faucet, and then flow on an ounce or two of solution *E*, keeping it in movement for 10 to 15 seconds. Longer than this will weaken the colors. The *E* solution may be used at times with advantage in modifying results of too great strength. But in the ordinary way it should not act for longer than 15 seconds, and should retain its pink color for this time. Then drain it off, rinse the plate for a few seconds under the faucet, let all water drain from the glass dish, and mix the intensifier in a clean glass, graduate by adding 3 drams of *G* to 4 ounces of *F*. Keep this mixture in movement over the plate until sufficient intensification is obtained. The intensifier acts fairly quickly—in 1 to 3 minutes—gradually darkening and becoming slightly turbid. If it is seen to be becoming slightly muddy in appearance, whilst the plate is not sufficiently intensified, it is best to mix a fresh lot and apply again, after first rinsing the plate and treating it for a moment again in *E* solution, followed by a brief rinse. But it will seldom be found that more than one dose of intensifier is needed.

The next step is to rinse for a full half-minute, and then to flow over the non-acid permanganate bath *H*, and allow it to act for a minute. This is to remove the yellowish tint over the high-lights, which is left by the intensifier. Then rinse again for a full half-minute, followed by 2 minutes in the hypo bath *I*. A final rinsing of 5 minutes suffices to remove the hypo, and to leave the plate in readiness for drying.

Though these operations appear tedious in print, they are very quickly carried out, the whole process occupying less than a quarter of an hour.

Failures and Defects

And now, having covered the ground so far as the making of an autochrome ready for binding to its cover-glass is concerned, we may briefly make a few notes of the chief defects which the finished result is liable to have.

Black Spots These are caused by dirt on the glass-side of the plate at the time of exposure, by air-bells on the plate during the first development, or by particles of undissolved amidol in the re-developer. The spot, in each case, consists of silver deposit, and can be removed by touching (on the dry plate) with a very small soft brush, moistened with the reversing bath, or with a solution of 15 grains iodine and 25 grains potass. iodide in 2 ounces of water. After applying the iodine, the plate is dipped for a moment in the fixing bath, *I*, and then rinsed for 5 minutes. Dr. D'Arcy Power touches such spots with sulphide-toning bleach, followed by hypo, which removes the spot entirely, and allows the plate, when dry, to be spotted to match the ground; or in many cases he finds it sufficient to touch the bleached spot with 2½ per cent sulphide bath (after washing one minute), the resulting brown spot being inconspicuous.

Green Spots Green spots or scratches are due to the varnish protecting the color-film being perforated, e. g., by dust between plate and backing card, or pressure of springs of plate-holder. The only remedy (a poor one) is to cut out the spot with a fine scalpel through to the glass, and then to fill in with albumen, retouching color after applying a touch of varnish. Some authorities have declared the bichromate reverser (page 115) to be superior to permanganate as regards freedom from green spots, but the only real preventive is to avoid all rubbing of any kind against the emulsion film coupled with development as soon as possible after exposure.

Pink Veil Pinkishness of the whole subject is the result of over-exposure, supplemented by over-development. In some cases, this effect seems to be due to undue action through the red grains of the color-film; in others, as we have seen, to the color-film being entirely bared of silver deposit in the reversing bath.

Blue Veil Bluishness, on the other hand, is due to leakage of white light through the lens, to under-exposure, or to the use of a light-filter other than that supplied for plates.

Both these general hues, if only slight, can be corrected fairly satisfactorily by tinting the whole autochrome either by a weak-dye bath, or better, by a tinted film, as mentioned in a later paragraph (page 126) for projection purposes.

Minor Faults

Bluishness of the greens is a common defect with beginners, and is due to under-exposure, followed by over-intensification.

Loss of strength and general weakening of the colors in the fixing bath, is due to incomplete re-development. The re-developer must act for a full four minutes, not merely until the plate seems fully darkened on the surface.

General darkness and density of the transparency arise from under-exposure, or under-development. The plate can be reduced in solution *E*, or one containing ¾ to 1 ounce of the reversing bath in 25 ounces of water, afterward intensifying slightly, if the result is somewhat flat in appearance.

Last, we come to frilling, which deserves a paragraph to itself as a serious difficulty.

Frilling

Those of us who used the Autochrome plates at the first will never forget the trouble required to keep the emulsion film from puckering up around the edges, or even leaving the plate altogether. This defect has been largely removed by the makers, but, from the nature of the plate, it is bound to arise more easily than with ordinary plates. If encountered now, it is usually in a much milder form, which does not call for the drastic measures, such as edging with wax or binding with surgical tape, which we used seven or eight years ago. Now, a generally sufficient preventive is to use a chrome-alum bath of strength 90 grains in 20 ounces of water for a minute after rinsing from the reversing solution, again rinsing and re-developing as usual, but preferably with amidol. Another plan is to rinse the plate quickly after the reverser, and then to whirl it dry before proceeding to re-develop. It hardly need be said that the developing and other solutions, as also the wash-water, should not be above 65°. When working in hot countries, where ice cannot be had, it is necessary to develop late at night, or in the early hours of the morning.

Viewing Autochromes Before passing to some by-paths of Autochromy, the chief of which are stereoscopic and flashlight work, extra-sensitising the plates for more rapid exposures, and the making of transparencies in duplicate, I may bring these notes on the regular process to an end by dealing with the showing of larger Autochromes, and the projection of the smaller ones. Daylight is the light by which to view an Autochrome. By no other does it show the full perfection of its color-rendering, except by the aid of more or less elaborate means to bring the illumination into correspondence with daylight. For the viewing of a single transparency, there is no more convenient appliance than the so-called "Diascope," viz., a frame in which the plate is held, so that one is able to look at its reflection in a mirror. It is simply the usual pattern of re-touching desk turned back to front, with a mirror laid on the baseboard, and with the autochrome placed in the holder for the negative. This arrangement allows one to examine the transparency at ease when seated at a table, whilst the plate, owing to its inclined position, gets the best light in a room, viz., that coming through the upper part of the window. Moreover, when the frame is closed, the Autochrome is protected on each slide.

The showing of autochromes in number at an exhibition is not such an easy matter, for it is almost always necessary to provide artificial light for the evenings. One plan is to set apart a darkened room, and either to erect an upright partition in it for the support of the transparencies, or to provide a big rectangular frame-work for the same purpose. In the one case, the lights are placed behind the partition; in the other, within the frame, every atom of space between the transparencies being blocked up with stiff black paper. The lights may be three or four open arcs, or high-power nitrogen bulbs, or a much larger number of ordinary metal-filament lamps of fifty-candle power. Whichever is used, a diffusing screen of ground glass requires to be placed about two or three inches back from the Autochromes, and further diffusion of the light obtained by having the floor of the chamber white. I have found this mixture of reflected and direct light to work well with both arcs and incandescent bulbs. With the latter, it is well to attach a very pale blue tissue paper to the ground glasses, in order to counteract the greater yellowness of the light; otherwise the lighter tones of blue in the transparencies show very poorly, and yellows tend to disappear. At the exhibitions of the Royal Photographic Society, the Autochromes are shown on the Diascope system in frames about twelve feet in length, and of depth to accommodate two rows of 5 x 7 plates. In the daytime, the light from the roof of the gallery is used—incandescent gas, after dark,—and the result in both conditions is excellent. One final hint may be given on showing collections of Autochromes, and that is to isolate each as widely from its neighbors as is possible. Each gains immensely in brilliancy and effect by an ample surrounding of darkness.

Projection

A high-power illuminant, such as an arc-lamp or oxy-hydrogen jet, is necessary for showing Autochromes effectively on the screen, on a scale of 6 to 10 or 12 feet from a three-inch transparency. Such strong lights heat the slide considerably, and it is necessary not to keep it in the lantern longer than about half a minute, otherwise the color may be entirely destroyed. A glass trough filled with water cuts down the heat of the light considerably, and allows of a longer period. It is usually fitted between the condenser and the slide carrier, although one British maker, Messrs. Beard, puts it between the lenses of the condenser and further connects it to a water reservoir above, by which the water in the cell is kept cool on the thermo-siphon principle adopted for motor-car radiators. But equally important is the openness of the lantern-stage. In many lanterns, the slide is kept boxed-in to such an extent that the stage is virtually an oven. For autochromes, in particular, the stage needs to be open, top, bottom, and sides, so that there is a clear air-space of four or five inches in width in the side facing the light. This again helps immensely to keep the transparency cool, and is adopted in many up-to-date stereopticons.

The screen also requires to be of the best, preferably painted in zinc white on a solid wall, or, failing that, one of the opaque screens sold by the dealers in lantern requisites. A "silver screen," i. e., one coated with aluminum paint, gives a very much brighter picture, and is suitable for smaller audiences where usually a light of moderate power is used.

A hint may not be out of place in reference to lantern shows where Autochromes alternate with ordinary lantern-slides. In contrast with the brilliant projection of the usual diapositives, the Autochrome looks exceedingly dull, although, after one or two have been shown, the dull appearance ceases to be noticeable, since one's eye accommodates itself to the lesser intensity. For this reason, when passing from an ordinary to an Autochrome slide, it is a good plan to interpose a brief period of complete darkness on the screen, which is most conveniently done by placing perfectly opaque dummy slides in the required places, explaining their object to the operator. This saves the abrupt change, and gives each Autochrome a chance to produce its full effect on the screen.

Tinters

As I have already said, a slight general tint over a color-transparency (Autochrome or Paget) can be largely corrected with a light tinting-glass, complementary in color to the hue which is in excess in the transparency. Thus, if the latter is too blue, we want a pale yellow tinter; if too red, a pale green; if too orange, a pale blue. The tinters require to be very pale, otherwise the other colors are affected, and the transparency made too dark as a whole. It is advisable to make a stock of a dozen or so by soaking old negatives in water, clearing away the image in the hypo-ferricyanide reducer, and well washing. The clear gelatine plates can then by dyed up in a bath of one or other of the dyes sold cheaply in packets for domestic use. From half to two grains of dye per ounce of water is strong enough. Use distilled or rain water, otherwise the tint may be scummy from lime in the water. Ten or twenty seconds usually suffices for a useful depth of tint, after which the plate is rinsed for a moment in plain water, and put aside to dry. With a few of these tinters at hand, one can try out their effect on a transparency which is too bluish or pinkish, and pick out one which will make a very marked improvement. The tinting glass is then simply bound up in place of a plain cover glass.

Tinters for Projection

The yellowishness of all artificial lights in comparison with daylight makes it advisable to use a pale blue filter, in order to secure the best results on the screen. As in viewing transparencies, you then get a better rendering of the yellows. The tinter can be made as described in the previous paragraph, simply binding its edges with a gummed strip and using it in the lantern stage. For practical purposes, it is sufficient to make one or two and see which gives the best average result, although Von Hübl has given the following formula for a blue tinter to be used with electric arc: A mixture (warm) is made of 10 parts 1:15 gelatine solution; 1 part 1:1000 solution patent blue; 1 part 1:100 solution Rose Bengal, and 7½ parts of water. This is flowed on to glass in the proportion of 80 to 100 minims for every 16 square inches of glass.

Stereo Work

In stereoscopic work on the Autochrome plates, it is necessary either to use two separate plates or to cut the finished transparency bearing both pictures on the one plate. It won't do simply to turn the uncut one-plate transparency glass side to the lenses or prisms of the stereoscope. Therefore, of the two alternative plans, one must be chosen, preferably the use of a single plate, which is cut in half when finished, and the halves transposed in the usual way, and bound to a cover glass. The plates are supplied in the standard stereoscopic size of 6¾ x 3¼ inches, as also in the 45 x 107mm. size for special stereoscopic cameras. Of the two, the larger size is to be preferred, as the color grain of the Autochrome becomes very pronounced when the transparency is subjected to the considerable magnification which it gets in stereoscopes made for the pocket stereo-camera slides. For details of lens-separation and mounting and masking the finished transparencies, I must refer the reader to THE PHOTO-MINIATURE, No. 98. The rules there given apply equally to results on autochrome plates.

Flashlight Portraits

Indoor portraits are about the most difficult of subjects for the Autochrome plate, on account of the great length of exposure, but by means of flash powder an instantaneous exposure can be given and supremely beautiful results obtained. In fact, no finer Autochromes have ever been made than those by Mr. J. W. Allison, of Allison & Hadaway, New York, with this firm's "Panchroma" flash powder. In flashlight work, a special lens-filter must be used; that employed for daylight will not do. The makers of Panchroma supply filters for use with their flashpowder. As regards the arrangement of flashpan, sitter, and camera, the light should be placed about five feet from the sitter, and a little to one side or other of the camera, which directly faces the sitter. There should be plenty of reflected light. If a small room (about 5 x 7 feet) with white walls can be found, well and good; but usually it is necessary to make a room of this kind by means of white screens, not forgetting one about thirty inches wide about three feet above the sitter, so as to form a white shelf extending before and behind the sitter. Hints on the management of the light and the quantity of powder to use will be found in the instructions issued by the manufacturers of color-plates and special flashpowders used in this work.

Extra-Sensitising

By means of a dye bath worked out by M. Ch. Simmen, and supplied by the Lumière Co., the speed of the Autochrome plates can be increased about five times, and snapshot exposures of about 1/25 of a second can thus be given with an *f*/4.5 lens. I need not give instructions for the use of the bath, as these are fully detailed in the Lumière instructions. A special lens-filter is required for use with the extra-sensitized plates, and is supplied by the Lumière Co., as are also others for use when employing the bathed plates by flashlight.

Copies of Autochromes

Although the one transparency obtained is (at its best) of beautiful quality, the Autochrome process is not one which naturally lends itself readily to the making of several duplicates from one exposure. Although at first sight it seems a simple matter to print from one autochrome on to another of the plates by contact, and to pass the copy through the regular process of development, reversal, etc., the result is unsatisfactory as regards sharpness and color-rendering, unless special precautions are taken, and even then the copy is never equal to the original. The most satisfactory method of all is to make the original as a negative transparency (i. e., in complementary colors) by development, fixing and, if necessary, intensification, without reversal. But, as a rule, one wants to make copies only of specially fine Autochromes, and therefore the process resolves itself into working from a positive color-transparency onto a second Autochrome plate and developing, etc., in much the same way as for an original. About the handiest way of doing this is to fix the Autochrome close in front of a condenser, and to illuminate it by incandescent gas or acetylene. In order to avoid overheating of the Autochrome, it is best *not* to use an enlarging lantern, but to rig up a support for the condenser, and to put the transparency so that air can reach it freely on all sides. As handy a way as any is to fix it at the back of a good-sized camera, the lens panel of which is removed and the lens of a smaller camera pointed through it, so as to copy the original on the required scale. This lens must be fitted with a filter made for whichever light is used. Exposures will range from 30 seconds to several minutes. They should be full, and the plates developed with the Lumière metoquinone of rather weaker strength, say 1:6 or 1:8, instead of 1:4, adding a little full-strength stock after the image has appeared. If a negative transparency is used, exactly the same plan is followed, except of course, that the plate requires no reversal or redevelopment.

The Paget Process In a previous paragraph (page 99) I have briefly described wherein the Paget process differs from the autochrome, whilst in No. 128 of The Photo-Miniature the reader will find an account of the distinct forms of the process devised by the Paget Prize Plate Co., Watford, England. At present the materials for only one of these are on the market, and are obtainable in this country from the Herbert & Huesgen Co., New York. This is the so-called "duplicating" process, according to which any number of color-transparencies may be made from a single negative.

The Taking Screen The starting point is the taking screen made up of minute rectangular red, green, and blue-violet areas, each about 1/300 of an inch. The panchromatic plate is exposed film to film with this taking screen and through the latter, the extra blue-sensitiveness of the plate being corrected by the use of a yellow filter on the lens, as in the Autochrome process. All that has been said in regard to the fitting of the lens-filter, and to the reversal of the ground-glass, applies equally in the Paget process, except that the special Paget filter and Paget plate must be used, and that it is the thickness of the taking screen, and not of the sensitive plate, which must be taken into account. It is most important that the plate be pressed into firm contact with the taking screen, for which reason the British book pattern of plate-holder is certainly preferable to any other. Even with these, a difficulty is the thickness of two glass plates, instead of one, in each part of the holder; but this, if it arises, is surmounted by using the taking screens and plates prepared on extra-thin glass, which are issued by the Paget Company. These will be found best also for use in American solid-pattern plate-holders, the construction of which allows of satisfactory contact between the two surfaces. If this is not secured all over, the result is wrong color-rendering, or entire absence of color in parts. If possible, put the taking screens into the holders in daylight, so as to be certain that they are correctly placed, i. e., glass-side toward the lens.

The taking screen requires to be taken care of in the way of keeping it from getting scratched, and from exposure to light. If that is done, one will last for hundreds of exposures. Anyway, the cost is not great, and it is best to get a supply according to the number of plate-holders, with one or two extra to have at hand in case of accidents.

Loading Holders The Paget panchromatic plates on which the exposures are made must be handled in darkness, or in a green safelight. The Paget Company supply special safelights, or I have found that the Virida papers (three yellows and two greens with a 16-candle-power bulb) yield a suitable illumination for both loading and development. The glass side of each taking screen is carefully cleaned, and the coated side, as also that of the plate, wiped free from dust with a bit of soft cotton velvet, remembering that the most perfect contact between the two surfaces is a *sine qua non* in the process. For this reason, see that the springs of the book-form plate-holder give firm pressure, using, if necessary, a sheet of black card behind the plate.

Exposure The speed of the plates, through taking screen and lens-filter, is 12 Watkins or 18 Wynne, that is about three times that of the Autochrome, which is fast enough for slow shutter exposures in the best outdoor light and with a lens of *f*/6 or, better, of *f*/4.5 aperture. As with the Autochrome, the exposure requires to be longer than the regular proportion when the light is dull, or a small stop is used. I will not say that this necessity is so marked with Paget plates as with the autochrome. It is, however, a very safe plan to follow the rules already given for the autochrome, but reducing exposure to one-third. It is better to err on the side of over- than under-exposure, for the ideal negative is one which is soft and thin, with the detail of the pattern of the taking screen throughout all the tones.

Development A soft-working developer must be used. Rodinal, of strength 1 part in 30 parts of water, answers well, development being complete in two minutes at 65° F. It is quite satisfactory to work by time in darkness, but, if you use the green safelight, keep the plate covered as much as possible. After a brief rinse, the plate is fixed in an acid bath of: Hypo, 6 ounces; potass. metabisulphite, ½ ounce; water, 20 ounces; and when washed and dried is ready for printing.

The Positive Transparency Diapositive plates are supplied by the Paget Company. They are similar to lantern plates, but give an image of specially intense black tone and brilliance. They are handled just like lantern plates, that is in bright orange light. First examine the negative, to see that the emulsion has not formed raised ridges round the edge, as it may do through handling with the fingers when wet. If the edge is not perfectly smooth and even all around, it is best to cut and scrape away a strip about one-eighth of an inch all around with a sharp penknife; any minute lumps of the edge will interfere with proper contact of the positive plate. Also use a printing-frame with strong springs, pushing the negative and the positive both into one corner. This keeps the sides of the two plates parallel, and facilitates the registration of the positive with the viewing screen. Exposure is short—about five seconds at three feet from a sixteen-candle-power electric carbon-filament lamp, but one can often place the frame farther away with advantage, the longer exposure then allowing of parts of the negative being shaded during printing.

Developing the Positive This is perhaps the stage of the Paget process in which beginners find some difficulty. The transparency is unlike an ordinary lantern-slide in the fact that it has the pattern of the taking screen running all through it, and this pattern requires to be sharply rendered in the diapositive as opaque deposit, in order to give good color-rendering. The special developer supplied by the Paget Company is the best I have used, but a hydroquinone formula made up with caustic soda works very well. Keep the solution in movement for the whole time of development, and use a fresh lot of developer for each plate. The plate must be developed to greater brilliance and density than is right for ordinary lantern-slides, otherwise the color effect will be weak. A good guide is the appearance on the back; detail in the shadows should be just distinctly visible. When this stage is reached, fix at once in the acid hypo bath, given above for the negative plates, and wash and dry.

Registration

Now comes the last stage in the process, viz., binding up in register with the viewing screen. Here, again, see that there is no ridge of wrinkled film on the edge of the positive plate, as already directed for the negative. The next thing is to provide a source of light which is low down, and so saves one the fatigue of holding the plates up and out at arm's length when adjusting one or the other. I get any kind of box, lay a sheet of ground glass on the top, and rig up a fifty-candle-power bulb just below it. Set the box on the floor, and seat yourself beside it. Then with the elbows supported on the knees, you can handle the glasses comfortably over the light. If you use the square (3¼ x 3¼ inch) positive plates (the standard English lantern size) and viewing screens to match, you require to notice the scratch on the film along one side of the latter. The side bearing this scratch must be in alignment with the side of the diapositive which was in contact with one of the longer sides of the negative when printing. In the case of 3 x 4, or quarter-plate plates, there is no need to trouble.

Now lay the positive and viewing screen film to film, and slowly rotate with the first fingers and the thumbs. A very minute movement will produce a checker pattern, or moirée, which gets bigger and bigger as one plate is turned upon the other. Then with a little further movement the pattern disappears altogether, leaving the whole plate of some one color. At this stage, a couple of bull-dog letter clips are slipped on opposite sides of plates to clamp them finally together. A *very* slight movement of one glass over the other, straight along one way or the other, will cause all the colors to appear in their true values.

Intensification or Reduction

Now we can judge if the result is satisfactory, or if it can be improved by further treatment of the diapositive. If the colors are poor and weak, the positive probably requires intensification, for which purpose there is nothing better than the chromium intensifier, used according to the full instructions given at page 536 of THE PHOTO-MINIATURE No. 143. On the other hand, too great density and depth of colors can be corrected by the use of the Farmer ferricyanide reducer.

Binding

The positive, with or without after-treatment, having been obtained in registration and held by the letter clips, it only remains to bind the two glasses together with the usual gummed strips used for lantern slides or, better, the somewhat stouter gummed edging sold for passe-partouts. A good tip here for avoiding slipping of the glasses under the clips, when applying the gummed strips, is that of Dr. D'Arcy Power, viz., to run a touch of fish-glue around the edges of the two plates and leave it to harden before putting on the paper binding.

Projection

The advantages of the Paget color slides over autochromes for projection are: first, their much greater transparency, and second, their comparative immunity from damage by the heat of the lantern. The latter quality is such that the slides can be treated pretty much as ordinary lantern slides, although it must be borne in mind that the viewing screen is liable to suffer from excessive exposure in a hot lantern-stage, and that therefore an open stage is preferable also for these transparencies. For viewing, the Paget transparencies suffer from the defect of altering their colors if looked at obliquely; they must be viewed "square on," which practically can be done only by means of a box fitted with sight-hole or lens for the eye. This drawback is not possessed by the Paget "combined" process, in which the emulsion is coated on the color-screen-plate after the manner of the autochrome; but these plates have not yet been placed upon the market.

Pictures in Monochrome

The Paget process, it will thus be seen, has certain positive advantages, the chief of which is the facility with which any number of duplicates can be made. Moreover, the plates are just like those in ordinary use, and call for no special precautions in handling. A further point about the process is the ease with which an ordinary contact print, or enlargement upon a moderate scale, can be gotten from the negative made through the taking screen. The pattern of the screen is so fine that it is practically invisible in a matt print, and allows of 8x10 enlargements being produced from 3¼x4¼ or 4x5 negatives without structure showing to any unpleasant degree. Thus, with scarcely any addition to his equipment, the picture-maker obtains his lantern-slides in natural colors, and still can produce them in monochrome whenever he so desires.

The Hicro Process

In THE PHOTO-MINIATURE, NO. 128, several pages (383-392) were devoted to the processes by which paper prints or glass transparencies in natural colors are produced by superimposing one on the other, three differently colored impressions (pink, yellow, and blue-green) made from as many different negatives. The reader must turn to this earlier monograph for the plain story of the principle of such processes, scores of which have come up in the past, been heralded as "color-photography at last," and speedily been forgotten. But within the three years which have passed since NO. 128 appeared, a further great step has been made in bringing the triple superimposition process within the power of the unskilled. It is only necessary to give the name of its inventor, Mr. F. E. Ives, to provide the assurance that it is on theoretically right principles. Mr. Ives is recognized throughout the world as the leading investigator and authority in color-photography. But, in this new process, the "Hicro," he has done a good deal more then provide the theoretically right; he has reduced the practice to such a degree of simplicity and certainty that the making of prints and diapositives in natural colors calls for little more skill than ordinary photography. One might say, no more skill, but only somewhat more trouble.

What is the Hicro Process?

In the Hicro process, the first step is to make three negatives, recording respectively the redness, greenness, and blueness of the subject, but the difficulties and occasions of failure in previous methods are swept away by making the three plates for each exposure a complete one-piece triple unit, which has simply to be put into a holder and exposed in a camera with barely any more preparation than one ordinary plate. This is done by having the three plates in a hinged metal carrier so devised that, at the time of exposure, the green-sensitive has its glass side facing the lens, the red-sensitive is film to film behind it, whilst the blue-sensitive plate lies horizontally in the camera, and receives the picture from a yellow transparent mirror, brought into position at 45° to the lens-axis after the holder has been fitted to the camera. The only other screen is one of magenta color, close behind the lens, the whole arrangement allowing of the exposure being one-quarter of that for the Autochrome.

Development is done in a tank for half an hour, and the plates fixed and dried as usual.

The making of the three separate impressions has been similarly reduced to a simple system. The trio of negatives is placed in a special printing frame. On the two recording blue and green is placed a strip of sensitive bichromate film: on that recording red, a sheet of special blue-print paper. All three are exposed together to daylight for a time indicated by a piece of solio paper in an actinometer. The film is developed in warm water, washed and dried. It is then fixed in hypo, cut in two, and one part dyed magenta and the other yellow. The blue-print paper is developed, fixed, and washed and dried very much in the manner of a gaslight print. The assembling of these three prints on one another is done by clipping first the magenta and then the yellow film in register on to the blue base, and securing one edge with a strip of binding tissue. All three, spread apart, are then dipped for a few seconds in amyl acetate, put between blotters and run through a roller press, after which the complete color photograph can be trimmed and mounted like an ordinary print. These details are sufficient to describe the manipulations of the Hicro process, which are very fully set forth in the booklet issued by the company formed to exploit the method commercially.

The Kodachrome Process

This method of producing color transparencies, worked out a little over a year ago by the Eastman Research Laboratory, differs from those we have already considered in the fact that it is a two-color process. The range of colors is obtained by recording the redness and greenness in the subject, and thus the process is admittedly defective in rendering blues, and colors such as violets and purples into which blue largely enters. But it is offered essentially for portraiture, and in that branch is distinguished by its very beautiful rendering of flesh tints and hair. The process consists in taking simultaneously, or in quick succession, two negatives, one through a red and the other through a green screen. One of this pair of negatives is laterally reversed in comparison with the other by the use of a prism, or by exposing one plate glass-side to the lens. The negatives are developed in the ordinary way. Then, either with or without fixing, washing, and drying, they are passed into a bleaching bath, by which the developed image, or rather the gelatine in contact with it, is converted into a state in which it absorbs dye very slowly, whereas the unaltered gelatine of the emulsion (that containing little or no silver deposit) absorbs the dye readily. The result is that each negative yields a dye positive, that taken through the red screen being dyed green, and that through the green screen red. These two dyed positives are bound up in register to form the color transparency. Worked in this way, the process yields one color portrait from each exposure, but the bleaching and dyeing can be applied just as well to reproduced negatives, and any number of duplicate transparencies can be thus produced by this method.

Kodachrome in Practice

The details of the process have been very fully worked out by the Eastman Company, by whom all the chemical preparations and appliances are supplied, including an installation of nitro bulbs for the exposure, the process requiring a very powerful light in the studio. Little can be said here in supplement to these instructions, which are particularly full in respect to the only part of the process—the dyeing of the plates—which is something outside the track of regular work with panchromatic plates. The dye baths should be free from deposit—made and kept so by filtering—and should be maintained at full strength by addition, every little while, of fresh bath to that which has been in use. Plates should take up dye quickly (in about three minutes), and the take-up is finished as soon as full detail is brought out in the high-lights. The plates require a brief rinse with water, in order to judge of this point, and one can then be laid on the other and examined by artificial light, to judge of the color effect. If the whole result is too red or green, a little further dyeing of the other plate in its dye-bath will correct; but, generally speaking, the art in the process consists in dyeing quickly and passing the plates to the acetic stop-bath without letting plates hang about in the wet state. After the acetic bath, they are mopped surface-dry, and dried as quickly as possible with a fan. The green plate is then laid glass-side down on the film of the red plate in register, and the two clipped together. A thin binder is then put on, and, when this has dried, a cover-glass attached over the film of the green plate, and secured with stout gummed edging.

—George E. Brown.

BOOKS

Photography in Colors. By Dr. Lindsay Johnson. A non-technical explanation of color photography in principle and practice. Second (Revised) Edition, 1914. 244 pp., 5 plates in color. Cloth, $1.25. Tennant and Ward, New York.

The Photo-Miniature: No. 128. Color Photography. By George E. Brown. A descriptive account of the modern methods of obtaining photographs in color, giving principles and comparisons rather than practical instruction in manipulation. Price 25 cts. Now out of print, but obtainable from some dealers and accessible at the principal public libraries.

MAKING ENLARGEMENTS ON PLAIN PAPER FOR CRAYON FINISHING

Where portrait enlargements are required in quantities for crayon finishing, these can be made upon plain paper as readily as upon bromide paper, at very much less expense. Such enlargements were formerly known as "solar prints," and the method here described is still used by many large houses, turning out thousands of these enlargements year by year. The method calls for a negative soft and detailful, without harsh contrasts, such as are ordinarily made in the professional portrait studio.

The Paper

The paper best suited for producing enlargements on plain paper may be obtained from most dealers in photographic supplies or artists' material under the name of Steinbach or Saxe paper. It is imported in rolls about 40 inches wide, but some photographic dealers retail it in sheets 18 x 23 inches at about 50 cents per dozen sheets.

Either of the above papers requires to be salted. As the paper, when salted, keeps in good condition for months, it is advisable to salt a number of sheets at one time. For the salting, we need a perfectly clean tray, and a few wooden clips with which to suspend the paper until dry after salted.

Salting Solution

For the salting solution, we shall need a supply of serum of milk, and this should be prepared according to the directions given in the method for making enlargements upon fabrics. The salting solution is prepared as follows: Serum of milk, 42 fluid ozs.; potassium iodide, 1½ ozs.; potassium bromide, 160 grains. An alternative formula is as follows: Magnesium iodide, 1½ ozs.; serum of milk, 40 fluid ozs.; ammonium bromide, 218 grains; magnesium chloride, 80 grains. The salts in these solutions will dissolve quickly. When thorough solution has been obtained, the mixture should be carefully filtered through a tuft of absorbent cotton placed in a glass funnel and poured into a clean tray ready for use.

Salting the Paper

To salt the paper, mark each sheet with a faint pencil mark to indicate the *back* of the sheet. Now take hold of the paper at the opposite diagonal corners with the finger and thumb of each hand so that it sags in the middle. Lower the sheet carefully down upon the surface of the salting solution so that it goes down upon the surface from the center of the sheet toward the corners held by the fingers. Now lift it up by one corner and see whether any air bubbles form upon the wet surface of the paper. If so, touch them with the finger and they will disappear. After examining the whole sheet from the four corners in this way, let the paper remain on the surface of the salting solution for three minutes, after which it should be lifted with a gentle sliding movement from the solution, drained, and suspended to dry. This salting of the paper may be carried out in daylight. When the sheets are dry, they should be kept flat in a portfolio or under pressure away from dust until needed for sensitizing. The sensitizing, of this paper, and all after operations, should be conducted in an orange-colored light.

Sensitizing Formula

Distilled water, 32 fluid ozs.; nitrate of silver (re-crystallized) 3 ozs.; glacial acetic acid, 4 fluid ozs. The sensitizing solution should be applied to the salted surface of the paper, either by means of a tuft of absorbent cotton held in a glass tube to form a brush, or by the use of a cotton swab, as described in sensitizing fabrics. Where a vignette is desired, or only a portion of the paper is to be sensitized, the tuft of cotton in the tube will be found most convenient, and the sensitizer may be applied for about two minutes. If the whole sheet is to be used, then it will be better to float the paper upon the surface of the sensitizing solution, letting it remain thereon for three minutes, then withdrawing the sheet from the surface of the solution over a glass rod placed at the end of the tray.

Exposing the Paper

The picture to be enlarged is supposed to be already adjusted in the enlarging camera and focused upon the enlarging board or easel with the lens capped. Now fix the wet sensitized paper to the enlarging board or easel, remove the lens cap, and give the exposure. This will vary according to the quality of the negative, the degree of enlargement, and the distance of the easel from the lens. Five seconds may suffice in some instances, or it may run into as many minutes. A safe rule to go by is to examine the print upon the board during exposure. As soon as a faint image has made its appearance, the paper may be removed and developed at once. Either of the following developers may be used at will.

Developer Formulas

Water, 38 fluid ozs.; gallic acid, 284 grains; acetate of lead, 192 grains; glacial acetic acid, 3 fluid ozs. *Alternative* (pyro) developer: Water, 64 fluid, ozs.; pyrogallic acid, 180 grains; glacial acetic acid, 5 fluid ozs.; saturated solution citric acid, 20 drops. *Alternative* (iron) developer: Distilled water, 30 fluid ozs.; protosulphate of iron, 1 oz.; glacial acetic acid, 2 fluid ozs.

Development and Fixing

Lay the print, with the pencil-marked side down, in a clean tray, and pour the developer over the damp surface with one clean, even sweep of solution. The progress of the development of the image should now be carefully watched. As soon as the image is well out, pour off the developer, wash the print well in running water, then fix in a plain solution of: Water, 160 fluid ozs.; hyposulphite of soda, 32 ozs.

The time required for fixing a print of this kind will usually be fifteen or twenty minutes. In fact, it should remain in the hypo until the whites are quite clear, which may readily be seen by examining the print in white light. When every trace of yellow silver iodide has been eliminated, as judged by inspection, the print is fixed and may be washed for an hour in running water, after which it may be dried or pasted while wet upon cardboard or the usual canvas stretcher.

Toning if Desired Such prints may be further toned or strengthened in color by toning in a gold toning bath, such as the one recommended for toning prints upon silk. The addition to the fixing bath, as given above, of 8 grains of chloride of gold dissolved in 4 ounces of water is also recommended as giving prints rich in color.

Theater Posters For the production of very large solar prints, such as are used as the base for the life-size colored theatrical posters, now so much used in theater lobbies, the method already given is slightly varied.

Salting For the salting solution, the following is advised: Milk serum, 20 fluid ozs.; glacial acetic acid, 12 drops; iodide of potassium, 160 grains; bromide of potassium, 80 grains; the albumen of two eggs. The albumen should be equal to 2 fluid ounces in volume, and should be well beaten to a froth with a silver or plated-silver fork. It is first added to the serum, after which the salts are added, with continual shaking. After solution is complete, the mixture should be filtered and lightly applied to the paper with a cotton swab. This operation should occupy about two minutes for a sheet, say, 40 x 40. The salted paper is then suspended by clips to dry, away from dust.

Sensitizing The sensitizing is also done by swabbing the sheet with the following solution: Distilled water, 5 fluid ozs.; nitrate of silver (re-crystallized), 200 grains; glacial acetic acid, ½ fluid oz. After exposure as usual, the print may be developed in any of the developers already given, or the following may be used: Water, 20 fluid ozs.; pyrogallic acid, 2 drams; glacial acetic acid, 2 fluid ozs.; potassium bromide, 8 grains. After development, the prints should be well rinsed and fixed in a bath made by dissolving 1 pound hyposulphite of soda in 40 ounces of water. Fifteen minutes' immersion will suffice.

Toning or Intensifying The following toning solution is recommended for the toning or intensifying of solar prints. Prepare *Solution A*: Distilled water, 20 fluid ozs.; acetate of soda, ½oz.;

ammonium sulphocyanide, ½oz.; hyposulphite of soda, 4 ozs. *Solution B*: Chloride of gold, 10 grains; water, 2 fluid ozs. Solution A is most conveniently made with hot water. After the solution of A is complete and quite cold, add the gold solution B. This bath may be used repeatedly by adding occasionally an ounce or two of gold solution, prepared as directed for Solution B, to offset the sluggish action of the bath.

Notes and Comment

Mr. H. C. Lord, of the Emerson-McMillin Observatory attached to the Ohio State University, at Columbus, Ohio, has very kindly sent me a few extra copies of his paper on "The Making of a Photographic Objective," recently noted in these pages. If any reader desires a copy of this interesting description of how photographic lenses are made, I should be glad to send him a copy on request. This note will also serve as acknowledgement of the receipt of a further paper by Mr. Lord, on "The Illumination of the Field of a Photographic Objective," reprinted from the monthly notices of the Royal Astronomical Society. This paper deals with a detail of great importance in practical photography and, for those who do not mind mathematics, the explanation given by Mr. Lord will prove of considerable interest.

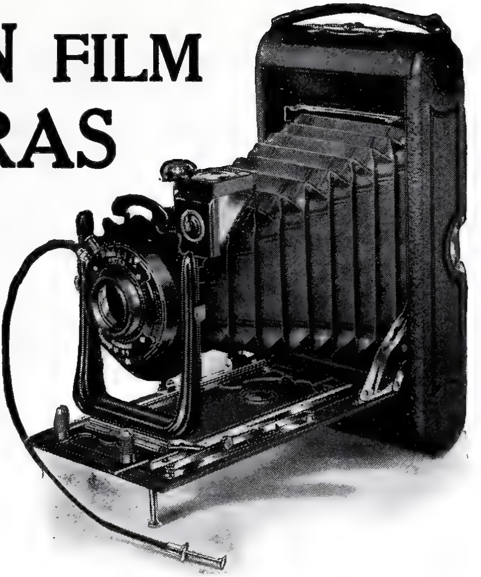
The question of exposure is, of course, "the eternal question" in photography. I note the appearance of at least four new exposure charts, meters, discs, etc., in the current magazines. Which serves to remind me that the handiest and most satisfying guide to the whole problem is to be found in THE PHOTO-MINIATURE No. 105, "Correct Exposure and How to Calculate It," with illustrations of the different classes of subjects.

Dr. C. E. Kenneth Mees, of the Eastman Kodak Company, has returned from a Bermuda holiday and is again busy in his research laboratory. There are rumors of changes which will greatly improve the Kodachrome process, making it simpler and more effective. I hear, also, of other novelties to come out of the Kodak City before the summer is over, which will be of unusual interest.

The new edition, 85th thousand, of the American Photography Exposure Tables, is completely revised, containing accurate tables for determining photographic exposures under all conditions and in all latitudes. It lists all plates and films now on the American market with their relative speeds, and offers much useful information on the subject of exposure outdoors and indoors by day or night, for still or moving objects, and for copying, reducing and enlarging. Price 25 cents. American Photographic Publishing Co., Boston.

From far-away Morobe, Papua, New Guinea, comes a letter of warm appreciation of The Photo-Miniature which an amateur of twenty years' standing had just discovered in that odd corner of the world. The writer was Sergeant of Police, Albert E. Smith, and accompanying his letter were three hand-camera pictures of groups of natives of New Britain and a village road. Mr. Smith tells of the many difficulties encountered in photography among the islands of the South Pacific because of the heat and dampness out there. He tells me that he finds the Nepera gaslight paper and bromide papers most reliable for that part of the world, and that, as a rule, time exposures with a tripod give better pictures than instantaneous exposures with the lens at its largest aperture. Apparently the use of Hypono is indispensable out there as eliminating 90 per cent of the time usually occupied in washing plates and films and thereby saving the negative film from deterioration.

ENSIGN FILM CAMERAS



The Camera here shown is a Standard Improved Round End Model Film Camera which sells for $25.00 for 3¼ x 5½, or $22.50 for 3¼ x 4¼ pictures, including an Ensign Anastigmat Lens F. 7.7, and will compare favorably with any similar type of camera selling up to $40.00 or money cheerfully refunded.

Ensigns are extra value in all classes from the $2.50 Box type up.

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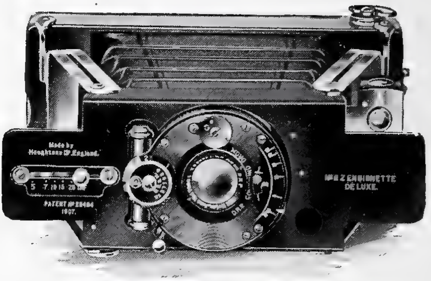

The ENSIGNETTE CAMERA

The original and only actual Vest Pocket Camera

A small practical camera that can always be carried. Secure those little scenes that come at unexpected moments. Always ready. Made of metal throughout, handsomely finished. Picture size: No. 1, 1½ x 2¼ ins.; No. 2, 2 x 3 inches.

PRICES	No. 1	No. 2
Regular; achromatic lens	$ 6.00	$10.00
Anastigmat Equipment F/6		$25.00
Cooke Anastigmat, Ser. IV F/5.8	$25.00	$35.00
Goerz Syntor F/6.8	$30.00	$40.00
Zeiss Tessar F/6.8	$35.00	$45.00

Above prices include carrying case.

The ENSIGNETTE DELUXE No. 2

Also "Fits the Pocket"

Selected high-grade lenses with shutters of great speed and precision combine to make our outfits of exceptional flexibility for the serious worker.

PRICES	
DE LUXE ENSIGNETTE No. 2-Z, with Carl Zeiss Tessar F/6.3 lens in compound shutter, with velvet-lined black grained leather case	$55.00
DE LUXE ENSIGNETTE No. S, with Carl Zeiss Triotar lens F/6.3 and Pronto shutter, with velvet-lined leather case	$37.50

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The Premier
American Made Camera
2¼ x 3¼ Roll Film

Auto Fixt Focus
TRADE MARK

PRICE $75.00

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18 East 42nd Street, near 5th Ave., New York

THE LENS OF SPEED

extreme speed, reliable speed and speed with covering power—that is, in a word, the

Bausch and Lomb
TESSAR Ic. F:4.5

MASTER OF SPEED AND LIGHT

Its unexcelled rapidity, three times that of an ordinary lens and double that of most anastigmats, sacrifices none of the other requirements.

Baseball pictures, athletic events, auto races—the kind of pictures that are hard to get with ordinary lenses, are easy with the Ic, especially in connection with reflecting cameras. On cloudy days or in deep shadows, where speed means economy of light, the Tessar Ic makes snapshots where slower lenses spell failure. The newspaper photographer must get his picture and get it quick. Owing to the great covering power in proportion to focal length, he does not hesitate to use it on larger plates in emergencies.

To catch the baby in those elusive poses, or the unconscious mannerisms of the grown-ups you need the Ic: Indoor snapshots are possible with this lens, because opening up the Tessar Ic means doubling the light of an ordinary anastigmat.

A new application of the Ic Tessar, F: 4.5, is in the fitting of the very small hand cameras. Owing to its precision, the negatives can be very greatly enlarged, and because of short focal length their depth at full opening exceeds in many cases the longer focus and slower lenses.

We are always glad to answer lens questions.
Ask for "Useful Tables for the Photographer,"
if you have not seen this pocket reference book.

Bausch & Lomb Optical Co.
634 ST. PAUL STREET ROCHESTER, N. Y.

Awarded Grand Prize for Balopticons
at Panama-Pacific Exposition

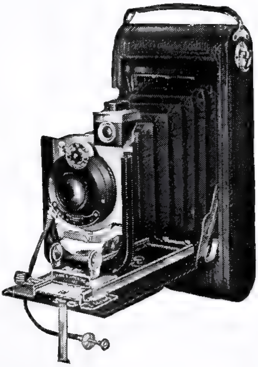
You Can Make Better Pictures With One Of The

REXO CAMERAS

Here are the reasons why:—

Simplicity of Construction—Every *Rexo Camera* is a model of simplicity. There is nothing complicated about it, nothing difficult to understand.

Perfect Rigidity—The one-piece U-shaped lens standard used on all *Rexo Cameras* is your insurance policy against blurred pictures due to the instability of the lens standard. This standard is very strong and absolutely rigid. It operates on a wide track and is always in perfect alignment with the focal plane of the film.



Easy Loading—*Rexo Cameras* can be loaded in considerably less time than other roll-film cameras. This great advantage is secured by the new film spool chambers, so constructed that you just drop the film into the receptacle and thread the black paper into the empty spool. No spool centers to pull out or mar the beauty of the camera.

Rexo Masking Finder—This new Finder is a triumph of simplicity and effectiveness. It shows only those objects which will appear in the finished picture. No guessing or disappointment. Instantly adjusted for either vertical or horizontal pictures.

Excellent Optical Equipment—We have taken especial precautions to insure the optical efficiency of *Rexo Cameras*. Every lens is scientifically tested and focused. If you do your part you will always get sharp pictures with *Rexo Cameras*. The shutters are all Ilex models—the most accurate and sure-acting shutters made.

These are some of the reasons why a *Rexo Camera* should be your choice. It is the biggest value in the camera world—*a master-piece.*

For Perfect Prints Use **REXO** A DEVELOPING PAPER ***The Guaranteed Developing Paper***

A Grade for every negative. Widest latitude in exposure and development. You'll make your best pictures on *Rexo*. Regular, Enlarging and Professional.

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FOR COLOR PHOTOGRAPHY

THE FAMOUS

GOERZ LENSES

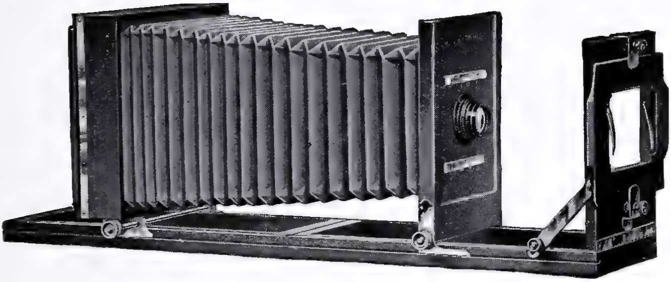
May Be Depended Upon For Results

THE well known GOERZ CELOR and DOGMAR lenses are especially well adapted for Natural Color Photography on Autochrome, Paget and the various Polychrome plates. In addition these lenses are most efficient for use in conjunction with a three color separation such as the Hess-Ives process. It is not only their great speed which recommends these lenses for color photography, but also their very perfect chromatic correction. This insures equal sharpness for all colors composing the image. GOERZ reputation is built into every lens and every lens represents GOERZ QUALITY. Write our correspondence department for descriptive matter. Your dealer will also be glad to give you information.

C. P. Goerz American Optical Co.

317F EAST 34th STREET **NEW YORK CITY**

The Graflex Enlarging Camera



The Graflex Enlarging Camera will make enlargements 8 x 10 and smaller, from negatives of any size up to 3¼x5½ or 4 x 5 inches.

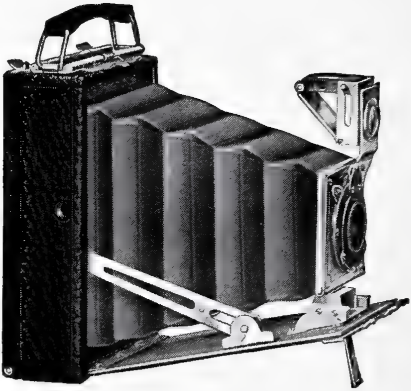
The negative carrier is provided with rising, sliding and oscillating movements, and may be tilted either toward or away from the lens.

THE PRICE

Graflex Enlarging Camera 8x10, with Zeiss Kodak Anastigmat Lens, f:6.3, 6⅛″ in barrel	$48.25
Graflex Enlarging Camera 8x10, without lens	25.00

Send for Catalog

FOLMER & SCHWING DIVISION
Eastman Kodak Company
ROCHESTER, N. Y.



$5.00

Premoette Jr.

To the pleasure of being out-of-doors, this little camera adds the further pleasure of making pictures of all that makes the out-of-doors worth while.

Just a trifle larger than the picture it makes, it can be carried in even a boy's pocket or a lady's handbag.

It is fitted with carefully tested lens, Kodak Ball Bearing shutter, and is dependably efficient in the fullest sense of the word. Will make pictures equal in quality to those made by the largest cameras.

Loads in daylight and invites by its appearance that confidence which it fulfills in results.

Prices

Premoette Jr. No. 1, for 2¼ x 3¼ pictures, $5.00
Premoette Jr. No. 1A, similar in all respects to the No. 1, but for 2½ x 4¼ pictures, $8.00.

Premo catalogue describing these and many other desirable models at prices from $1.50 to $150.00, free at the dealer's, or promptly mailed by us on request.

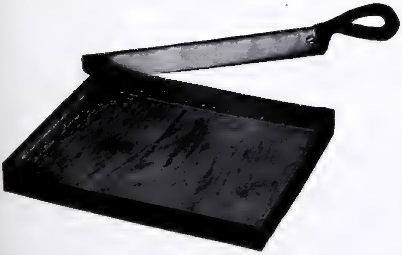
Rochester Optical Division, Rochester, N. Y.
Eastman Kodak Company

Eastman Kodak Company
ROCHESTER, N. Y., *The Kodak City*

The Panoram Kodaks

The key-note of the Panoram Kodak is specialization. It has its distinct field—a field large enough to demand all that a specialized Kodak can give it, and one that can be encroached upon by no other type of camera. As far as the amateur is concerned, the panoram field belongs exclusively to the Panoram Kodak. So it is that without a Panoram Kodak no photographic equipment can be complete.

The lens in the Panoram Kodak is mounted on a pivot which, with lever pressure, automatically swings from one side of the camera to the other, embracing an angle of 112 degrees with the No. 1 Panoram, and 142 degrees with the No. 4. The shutter operates simultaneously, insuring even lighting during exposure. In other words, the Panoram Kodak lens includes the whole view at a single exposure—not merely a piece of it as is the case with the ordinary type of camera. Whether it be outdoor groups, or broad vistas of picturesque nature, with the



The Kodak Trimming Board

Many a picture can be improved by careful trimming and all white margins should be exact. This simple little trimmer answers every purpose of the amateur.

THE PRICE

No. 1, capacity, 5 x 5 ins., .	$0.40
No. 2, capacity, 7 x 7 ins., .	.60
Transparent Trimming Gauge (extra)	.20

camera held in a horizontal position; or high water-falls, buildings, mountain peaks, etc., with the camera held vertically, the Panoram Kodak will produce pictures attracting immediate attention from their unusualness. Landscape pictures, for example, will give the effect of the freedom, the breadth of the out-of-doors, that the ordinary type of camera, from the very nature of its construction, can never approach.

The operation of the Panoram Kodak being largely automatic could hardly be simpler and still *be*. It's a case of you press the button, and it does the rest.

No. 1 Panoram Kodak

Details: For rectangular pictures, 2¼ x 7 inches. Capacity, 6 exposures without reloading. Size of Kodak, 3⅜ x 4⅜ x 7⅜ inches. Weight, 24 ounces. Lens, specially selected as to quality and focal length. Shutter, Panoram. Two tripod sockets. Brilliant finder with hood. Uses No. 1 F. P. Kodak cartridges.

Prices

No. 1 Panoram Kodak	$10.00
N. C. Film Cartridge, 6 exposures, 2¼x7 (No. 105)	40
Ditto, 3 exposures	.20

No. 4 Panoram Kodak

Details: For rectangular pictures, 3½ x 12 inches. Capacity, 4 exposures without reloading. Size of Kodak, 4¾ x 5⅝ x 10⅛ inches.

Kodak Magnesium Ribbon Holder

A handy little apparatus providing a strong printing light for gas-light papers and enabling the amateur to duplicate exposures with absolute exactness. The alcohol lamp provides a convenient means of igniting the ribbon.

THE PRICE

Kodak Magnesium Ribbon Holder	$0.20
Alcohol Lamp, for use with above	.20

EASTMAN KODAK COMPANY, Rochester, N. Y.

At your dealer's.

Weight, 2 pounds 14 ounces. Lens, specially selected as to quality and focal length. Shutter, Panoram. Two tripod sockets. Brilliant finder with hood. Uses No. 4 B. E. cartridges.

Prices

No. 4 Panoram Kodak	$20.00
N. C. Film Cartridge, 4 exposures, 3½ x 12 (No. 103)	.75
Ditto, 2 exposures	.45

AN ALBUM THAT DODGES THE AGE LIMIT

The Interchange is one album that absolutely refuses to be Oslerized. Even when the last page has received its full quota of prints, the active life of the album is far from ended. It is regularly furnished with fifty linen leaves—black only—but inasmuch as it is made on the loose leaf principle, extra pages may be added from time to time, as the photographic collection grows. So it is that the Interchange Album is unusually long-lived.

Some albums are quite properly kept out of sight when not in use. Not so the Interchange. It is far too handsome for that. The rich effect gained through the special embossed leather cover, with grain leather corners and back, adds to the attractiveness of any library table.

The price of the Interchange Album ranges from $2.50 to $5, according to size and style.

"BY FLASHLIGHT"

The booklet, "By Flashlight," which may be obtained free from your Kodak dealer or from us, gives you the story of flashlight work in readable form. Due to Eastman Flash Sheets, and the Kodak Flash Sheet-Holder, this interesting branch of photography has become comparatively simple. The amateur who can get good results by daylight should do equally well in flashlight work. Even the novice will find in "By Flashlight" all that he needs for successful results.

Eastman Flash Sheets are slow burning and give a soft, broad light that exactly answers the illumination requirements of the amateur. The Kodak Flash Sheet-Holder provides the ideal method for igniting the sheets and for directing the illumination. A saw tooth in the Holder secures the sheet in proper position, and a metal sheath is interposed between the operator and the flash. The Holder may be held in the hand or attached to a tripod.

Kodak Flash Sheet-Holder

The price of the Kodak Flash Sheet-Holder is $1.00.

Eastman Kodak Company

ROCHESTER, N. Y., ***The Kodak City***

THERE'S POINT IN THE POCKETFOTO

Several weeks ago at a neighborhood gathering, a friend of mine kept his Kodak shutter clicking merrily away, as well he might, for the children were dressed up in colonial costumes and presented at least one picture opportunity to the minute. Every time I've seen my friend since, I've asked him to show me the pictures; but they were always at home and all the satisfaction I could get was the fact that "they came out fine."

The Pocketfoto

Yesterday, however, it was a different story. "Here are those pictures," said my friend, "that you and about twenty-seven other people have been wanting to see for the past month," and he pulled from his pocket a neat little leather case. It looked like a pocket bill case, and fitted the pocket just as conveniently. Inside were the prints, twenty-four of them, but ample room for as many more. Good as the pictures were, it was the case that claimed my interest for the moment. It was such a sensible little thing, and so neat too. "What do you call it?" I asked.

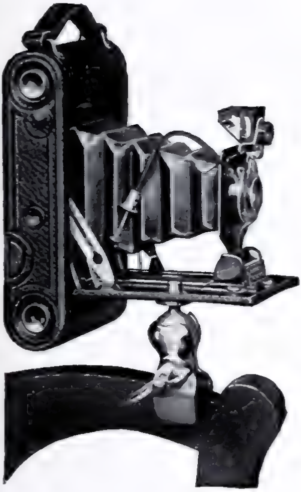
"Pocketfoto," he replied, "and it's the handiest little thing in the world. You know how it is. *You're* a Kodaker and how many times have people asked *you* if they might see such and such a print, and how many times have you been compelled to explain that the print was home? An album is too heavy and awkward to carry around, loose prints, or prints in an envelope, unsafe, but the Pocketfoto—just the thing."

The Pocketfoto that I bought from my Kodak dealer is bound to pay for itself in terms of satisfaction to myself and pleasure for my friends. It's just another Kodak refinement that puts the finishing touches on photographic pleasure.

The Price

No. 1, for 2¼ x 3¼ or smaller pictures, each . .	$1.25
No. 3, for 2½ x 4¼ to 3¼ x 4¼ pictures, each . .	1.50
No. 3A, for 3¼ x 5½ or smaller pictures, each . .	1.75

Two first aids to the time exposure:



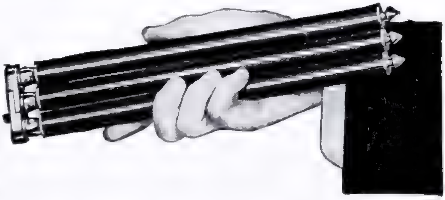
The Universal Clamp

A tripod substitute which, when attached to a chair, fence, automobile—in fact any rigid support, renders *full* tripod service. So light and small that it slips into any pocket conveniently.

Universal Clamp - - - - - -	-$ .75

The New Kodak Metal Tripod

a pocket tripod



Folds flat so that it has room to spare in the ordinary coat pocket. Rigid in construction, easy to set up and take down —conveniently handy, *always*.

No. 6 Kodak Metal Tripod - - -	$5.00

EASTMAN KODAK COMPANY
ROCHESTER, N.Y.

At your dealer's

VELOX TRANSPARENT WATERCOLOR STAMP
OUT
Velox Transparent Water Color Stamps
Manufactured by Eastman Kodak Co. Rochester, N.Y.

VELOX TRANSPARENT WATER COLOR STAMPS

offer "something-to-do" on the shut-in days or during the long evenings. You will find the coloring of prints and enlargements thoroughly delightful work and the ease with which artistic results can be secured will be a revelation.

The colors are self-blending and the book of directions is specific. To get the results you are after, you have but to follow directions.

THE PRICE.

Book of Velox Water Color Stamps (12 colors), ...	$ .25
Complete Velox Water Color Outfit, including book of color stamps, three brushes and palette, ...	.75

EASTMAN KODAK COMPANY,
ROCHESTER, N. Y.

At your dealer's.

There is just one temperature at which a solution does its best work

Eastman Thermometer

Absolutely accurate. Convenient for either tray or tank development, although particularly adapted to the latter, because of its hook top and curved back.

Price, $0.50

Thermometer Stirring Rod

Combines a reliable thermometer with a handy stirring rod. The flat end will be found useful for crushing chemicals.

Price, $0.60

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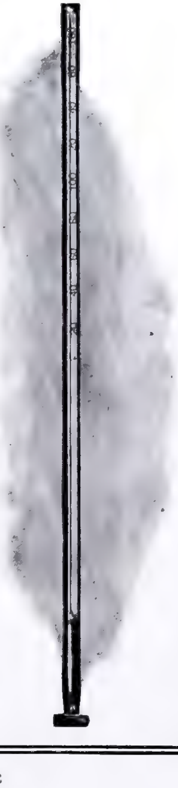
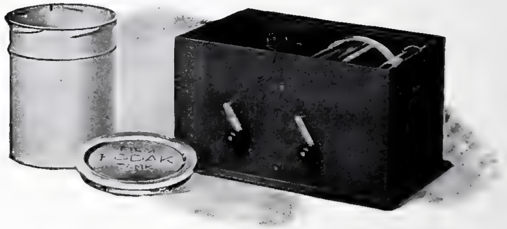




The novice who used a

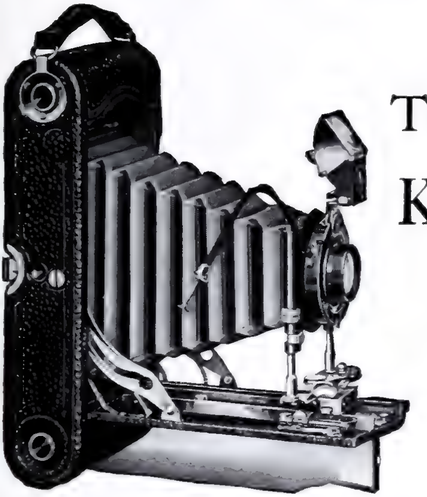
Kodak Film Tank

for the first time yesterday got better results than he could get by tray development in twenty years.

"The experience is in the Tank."

EASTMAN KODAK COMPANY
ROCHESTER, N. Y.

At your dealer's.



The New 3A KODAK

$27.50

THE LENS, The Kodak Anastigmat *f*.7.7 has a trifle more speed than the best of the Rapid Rectilinear lenses, and in quality (depth, *sharpness* and flatness of field) is fully the equal of the best anastigmats. Other anastigmat lenses are made to fulfil a dual purpose; they cover a certain size at their largest opening and cover a larger size as wide angle lenses, when used with a smaller stop. They are, therefore, corrected with a view to this double purpose.

The Kodak Anastigmat does not pretend to cover a larger area than that for which it is listed. But for its specific work, covering with minute sharpness the area which it is supposed to cover, none is better. This also means a saving in manufacturing. Which explains why we can sell it at a lower price than the other high-grade anastigmats.

THE AUTOGRAPHIC FEATURE.—You can *make sure*, can write the date and title on the film, permanently, at the time you make the exposure. After the last exposure you can similarly write your name on the film—an identifying mark that is valuable when you send your work to the finisher. And this "Autographing" the film is a matter of seconds only.

No. 3A Autographic Kodak, (3¼ x 5½), with
Kodak Anastigmat lens *f*.7.7, $27.50

All Dealers'

EASTMAN KODAK COMPANY

ROCHESTER, N. Y., *The Kodak City*

E. K. Tested Chemicals

are exactly what the name implies—chemicals that have been carefully tested by the Eastman Kodak Company and found to fulfill its necessarily exacting requirements.

Look for the seal—

it makes you certain:

EASTMAN KODAK COMPANY,
ROCHESTER, N. Y.

At your dealer's.

By increasing the Kodak's field of usefulness,

The Kodak Portrait Attachment

puts added pleasure in amateur photography.

Head and shoulder portraits, "close-ups" of every description are easily obtained through its means. It's simply an extra lens which, when slipped on over the regular lens equipment, brings nearby objects—objects within arm's length if you will—into sharp focus.

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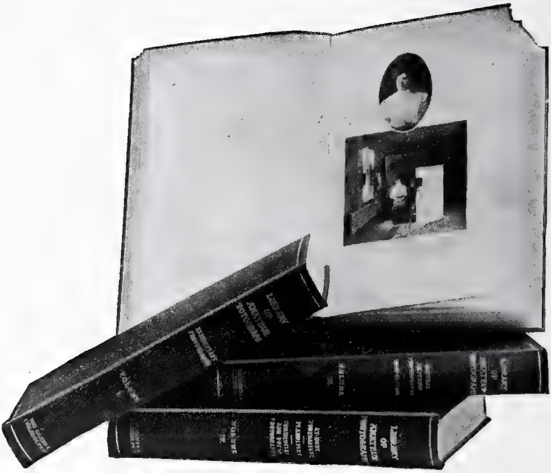

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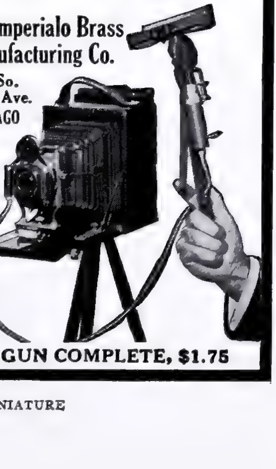

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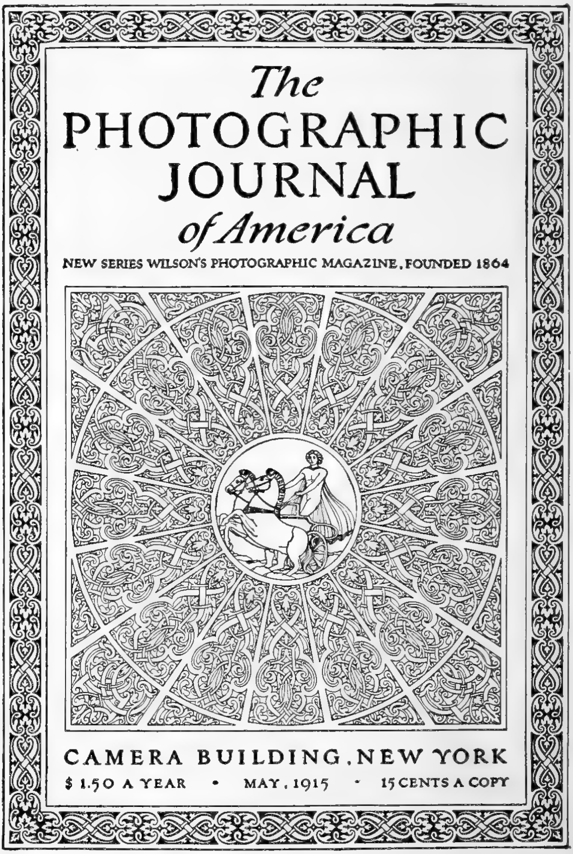

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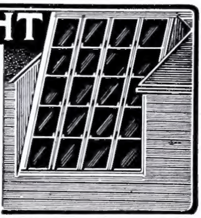

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